BULLETIN OF THE IMPERIAL INSTITUTE

A RECORD OF PROGRESS RELATING TO AGRICULTURAL, MINERAL AND OTHER INDUSTRIES, WITH SPECIAL REFERENCE TO THE UTILISATION OF THE RAW MATERIALS OF THE DOMINIONS, COLONIES AND INDIA

VOL. XXV. 1927

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ERRATA

Page 88, line 31, for *Journ. Agric. Sci.* read *Journ. Agric. Res.*
,, 196, lines 14-15, *for* Jansonius *read* Janssonius.
,, 280, line 27, for *Eucalyptus faloata* read *Eucalyptus falcata.*

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BULLETIN OF THE IMPERIAL INSTITUTE

VOL. XXV. 1927

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IMPERIAL INSTITUTE MINERAL RESOURCES DEPARTMENT

It has been decided to discontinue the publication of the Mineral Resources section of the Bulletin in the form in which it appeared during 1926. This course was recommended to the Governors of the Institute by the Advisory Council on Minerals after due consideration of the amount of time involved in its preparation and the pressing need for continuing the separate publication of monographs on specific subjects.

In future, mineral articles will appear in the Bulletin only when there is some outstanding and important subject to be dealt with, relating to mineral resources or laboratory investigations. Notices of books will be issued as heretofore, but the regular issue of articles, notes, abstracts, and monthly statistics will be discontinued.

The publication of monthly mineral and metal statistics was commenced in the first quarterly issue of the Bulletin of the Imperial Institute in 1926, and was continued through the year. The small space now available for statistics in the Bulletin renders it necessary to discontinue their publication; but the compilation of these monthly statistics will be continued, and they will be available for replies to any enquiries on particular minerals or metals.

Applications for information on the mineral and metal industries will be attended to as heretofore and should be addressed to the Director, Imperial Institute.

THE IMPERIAL INSTITUTE

South Kensington, S.W.7

GENERAL INFORMATION

THE Imperial Institute was founded as the Empire Memorial of the Jubilee of Queen Victoria. Its principal object is to promote the development of the commercial and industrial resources of the Empire.

Under the provisions of the Imperial Institute Act of 1925, the Institute has been reorganised and placed under the control of the Department of Overseas Trade. The Parliamentary Secretary of that Department is the responsible Minister and is Chairman of the Board of Governors. This body consists of the High Commissioners of the Dominions and India, representatives of the Colonial Office and of certain other Government Departments, and the Crown Agents for the Colonies, with additional members representing scientific and commercial interests. The Board has appointed Lieut.-Gen. Sir William Furse, K.C.B., D.S.O., as Director of the Institute. .

On July 1, 1925, the Imperial Mineral Resources Bureau was amalgamated with the Imperial Institute, and the fifteen Advisory Technical Committees of the Bureau have been reconstituted in the reorganised Institute.

For the purpose of carrying on the work of the Institute two principal Departments have been established, viz. a Plant and Animal Products Department and a Mineral Resources Department. An Advisory Council for each of these groups of products has been appointed, Sir David Prain, C.M.G., C.I.E., F.R.S., being Chairman of the Plant and Animal Products Council, and Sir Richard

Redmayne, K.C.B., Chairman of the Mineral Resources Council.

A number of Advisory Technical Committees consisting of authorities on the various groups of raw materials co-operate in the work of the Institute, in association with the Advisory Councils, and a close touch is maintained with producers, users, merchants and brokers. Valuable help can thus be given by the Institute to persons interested in the development of the resources of raw materials throughout the Empire.

Intelligence.—The Institute maintains a special service for dealing with enquiries relating to the sources, production, uses and marketing of raw materials and for collecting and disseminating general and statistical information on these subjects. This service is available for the use of individuals and firms, as well as of Government Departments, without charge.

Investigations.—The laboratories of the Institute are specially equipped for the chemical and technical examination of raw materials of all kinds. Full reports are furnished on the composition, uses and value of materials submitted. By its close association with the users of raw materials, the Institute is able to arrange large-scale trials of promising materials when necessary.

Special analyses and investigations are undertaken for firms or private persons in any part of the Empire on payment of appropriate charges. Applications for such investigations should be addressed to the Director.

Investigations on plantation rubber are condueted at the Institute in connection with the Ceylon Rubber Research Scheme.

Library.—The Library of the Institute contains a large collection of Colonial, Indian and other works of reference and is regularly supplied with the more important reports and other publications of government departments in Great Britain, the Dominions, Colonies and India, and most foreign countries. More than 500 serial publications, mainly of a scientific or technical character, are also regularly received.

The library is available (free of charge) for the use of enquirers between the hours of 10 a.m. and 5.30 p.m. on week-days (10 a.m. to 1 p.m. on Saturdays).

Statistical Section.—This section is concerned with the collection of statistics for the use of other Departments of the Institute.

Publications.—The BULLETIN OF THE IMPERIAL INSTITUTE contains records of the principal investigations conducted for the Dominions, Colonies and India at the Imperial Institute, and special articles, notes and abstracts, chiefly relating to progress in tropical agriculture, the development of mineral resources, and the industrial utilisation of all classes of raw materials.

Other publications of the Institute include a series of handbooks dealing with the Commercial Resources of the Tropics, with special reference to West Africa; Reports of the Indian Trade Inquiry; a series of Selected Reports on Investigations at the Institute; Monographs dealing with the Mineral Industry of the British Empire and Foreign Countries as well as a statistical series relating thereto; and a series of volumes on the Mining Laws of the British Empire and Foreign Countries.

Public Exhibition Galleries.—These galleries serve as a permanent exhibition of the natural resources, scenery and life of the people of the Dominions, India, and the Colonies. It is the only exhibition of the kind in London where all the countries of the Empire are represented under one roof. After being closed for re-decoration and for the installation of new heating and lighting systems, the galleries were re-opened to the public on September 29, 1926, the occasion being marked by a reception given to over 1,000 London school teachers who were addressed by Mr. Arthur Michael Samuel, M.P., Parliamentary Secretary to the Department of Overseas Trade, by the Hon. W. G. A. Ormsby-Gore, M.P., Permanent Under Secretary of State for the Colonies, and by the Duchess of Atholl, M.P., Parliamentary Secretary to the Board of Education.

A large number of exhibits, which had deteriorated, as well as show-cases of an obsolete type, have been

withdrawn from the galleries, and a more spacious lay-out has been adopted for the display of exhibits. A special feature has been made of pictorial representation, which takes the form of illuminated dioramas, transparencies and photographs. These are intended to attract the non-technical visitor and children, and to awaken in them an interest in the raw products which are shown in association with the illustrations. Descriptive labels are attached to all exhibits explaining in simple language their origin, occurrence, methods of cultivation or preparation, and uses. To render the galleries of further assistance to teachers in the study of Empire geography and development the exhibits are arranged in a definite sequence on lines suggested by the Advisory Education Committee of the Imperial Institute. Lectures and demonstrations in the galleries are given daily to school teachers and school children by the Guide Lecturers.

At the Central Stand which is maintained in the galleries for enquirers, free literature relating to Empire countries and products is distributed, and priced publications and picture postcards are on sale.

The galleries are open free daily from 10 a.m. to 5 p.m. and on Sunday afternoons from 2.30 to 6 p.m.

Imperial Art Gallery.—As a result of negotiations with the Royal Commissioners for the Exhibition of 1851, the upper east gallery has been set aside for exhibition of the works of selected artists from all parts of the Empire. The gallery is also utilised for judging and exhibiting the work of candidates for scholarships at the British School at Rome. The first main exhibition of Imperial Art will be held in April, May and June this year.

Cinema.—Rapid progress is being made in the construction and installation of a cinema for the display of films illustrating life and industries in the various countries of the Empire. The cinema will be in full operation for the opening of the Imperial Educational Conference in June. Special arrangements are being made for visits of organised parties of school children, to whom the displays will be free.

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REPORTS OF RECENT INVESTIGATIONS AT THE IMPERIAL INSTITUTE

Selected from the reports made to the Dominion, Colonial and Indian Governments

KOKERIT FRUITS FROM BRITISH GUIANA

In a report published in this Bulletin (1916, **14**, 8) an account was given of an investigation at the Imperial Institute of the pericarp oil, the kernel oil and the kernel meal obtained from a sample of kokerit (or cokerite) fruits sent from British Guiana. The fruits were identified at the Royal Botanic Gardens, Kew, as those of a species of *Maximiliana*, possibly *M. regia*. The Conservator of Forests, British Guiana, has recently informed the Imperial Institute that the fruits examined in 1916 were obtained from palms growing in the Botanic Gardens at Georgetown. As there was some doubt as to the botanical identity of the palms from which these fruits had been collected it was considered desirable to send further specimens for investigation, and these were received at the Imperial Institute in September, 1926. They had been obtained from the forests bordering the Berbice river and about 50 to 60 miles from the coast, and consisted of about 1 cwt. of whole fruits and a quantity of nuts which had been collected from the ground under the palms, and from which the pericarp had been eaten off by animals. In forwarding the samples the Conservator of Forests stated that one whole bunch of the fruits weighed 115 lb., of which 88 lb. consisted of fruits and the remainder of bracts, etc.

Specimens of these fruits were also submitted to the Royal Botanic Gardens, Kew, for identification. The Imperial Institute is informed that although the palm appears to be one which is grown in botanic gardens under the name of *Maximiliana regia*, there is some doubt as to

its exact identity and that the authorities at Kew are endeavouring to procure type specimens with a view to deciding the question.

The material received last year was as follows:

Fruits.—These consisted of pale to dark brown fruits in a moist condition. They were pointed at the apex and rounded at the base, 2 to 2½ in. long, and ¾ to 1 in. in diameter at the widest part; the base was covered with thin papery perianth segments. The fruits were identical in appearance with those previously received.

Each fruit consisted of pericarp, nut and kernels. The pericarp was tough and fibrous externally, but the inner portion was soft and oily. The nuts were pale brown, 1½ to 1¾ in. long and ¾ to 1 in. in diameter at the widest part. They had a very hard, thick, woody shell enclosing from one to three kernels, but usually two. The kernels were long, narrow, oval and flattened. They were from 0·8 to 1·2 in. long and 0·4 to 0·5 in. broad at the widest part. The interior of the kernel was nearly white and resembled that of palm kernels in consistency.

Nuts.—This sample consisted of nuts similar to those described above. A small amount of the pericarp remained attached to the shell.

The fruits were submitted to detailed examination with the following results:

	Grams
Average weight of a fruit	12·0
Average weight of a nut	8·7
Average weight of a kernel	1·1

Average composition of a fruit:	Per cent
Perianth segments	10·4
Pericarp	17·4
Shell of nut	56·9
Kernel	15·3

Average composition of the nut:	
Shell	78·8
Kernel	21·2

Examination of Pericarp

The pericarp contained 20 per cent. of moisture and on extraction with light petroleum yielded 10·1 per cent. of oil, corresponding to a yield of 12·6 per cent. from the moisture-free material, and to 1·8 per cent. from the whole

fruits. The oil thus obtained was a dark reddish-orange liquid which had an odour resembling that of palm oil (the pericarp oil of the fruit of the African oil palm) and on standing deposited a large quantity of stearins.

The oil was examined with the following results, which are shown in comparison with those previously obtained at the Imperial Institute for the oil from the pericarp and with those recorded for palm oil.

—	Kokerit pericarp oil.		Palm oil.
	Present sample.	Previous sample.	
Specific gravity at 100/15° C. . .	0·8590	—	0·859 –0·862
Refractive index at 40° C. . . .	1·4575	—	1·4531–1·4559
Solidifying point of fatty acids . ° C.	23·8	25·5	43–45
Acid value	70·1	28·6	20–160
Saponification value	206·9	211·6	198–202
Iodine value (Hübl. 17 hrs.). *per cent.*	56·1	51·4	52–57
Unsaponifiable matter . *per cent.*	2·3	—	—
Soluble volatile acids [1] . . .	0·55	—	0·86–1·87
Insoluble volatile acids [1] . . .	2·65	—	—

[1] *cc. of N/10 KOH required to neutralise the acids from 5 grams of oil.*

Examination of Kernels

The kernels contained 18·7 per cent. of moisture, and on extraction with light petroleum yielded 54·6 per cent. of oil, corresponding to a yield of 67·2 per cent. from the moisture-free kernels, and to 11·6 per cent. from the nuts

—	Kokerit kernel oil.			Palm kernel oil.
	Present sample.	Previous sample.	Bolton and Hewer.	
Specific gravity at 100/15° C.	0·8673	0·867	—	0·873
Melting point . . ° C.	28·2	27·0	26·0	21–24[1] 26–29[2]
Refractive index at 40° C. .	1·450	—	1·4513	1·4495–1·4510
Solidifying point of fatty acids . . . . ° C.	25·5	24·2	—	20–25·5
Acid value	2·6	3·1	1·0	5–22
Saponification value . .	248·5	253·0	240·9	245–248
Iodine value (Hübl. 17 hrs.) *per cent.*	10·5	13·0	16·56	14–17·5
Unsaponifiable matter *per cent.*	0·3	0·3	—	below 0·5
Soluble volatile acids [3] .	6·5	3·0	—	5–7·6
Insoluble volatile acids [3] .	11·6	7·0	—	10–12

[1] *Open tube method.*
[2] *Complete fusion.*
[3] *cc. of N/10 KOH required to neutralise the acids from 5 grams of fat.*

or 8·4 per cent. from the whole fruits. This oil was a cream-coloured, fairly hard fat with an odour resembling that of coconut and palm kernel oils.

The oil was examined with the results shown on page 3, which are shown in comparison with those previously obtained for the kernel oil at the Imperial Institute, with those obtained by Bolton and Hewer for kokerit kernel oil (*Analyst*, 1917, 42, 35), and with those recorded for palm kernel oil.

Examination of Residual Meal from Kernels

The meal left after the extraction of the kernels with light petroleum was pale pinkish-white and almost devoid of taste and odour. The results of the chemical examination are given in the following table together with the corresponding figures for the earlier sample of kokerit kernel meal, and with those for palm kernel cake. For convenience of comparison the results are calculated for cake containing 7 per cent. of fat, the average amount present in commercial feeding cakes.

—	Kokerit kernel meal.		Typical (English-made) palm kernel cakes examined at the Imperial Institute.	
	Present sample.	Previous sample		
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Moisture	13·2	8·6	9·5	10·8
Crude proteins	16·1	15·0	18·0	17·3
Fat	7·0	7·0	7·0	7·0
Carbohydrates, etc. (by difference	48·6	52·5	51·3	51·9
Crude fibre	10·3	12·6	10·2	9·6
Ash	4·8	4·3	4·0	3·4
Nutrient ratio	1 : 4·0	1 : 4·4	1 : 3·7	1 : 3·9
Food units	106	108	114	113

The meal was found to be free from alkaloids and cyanogenetic glucosides.

General Remarks

In appearance and composition the present kokerit fruits resembled those received previously but were slightly larger. The pericarp contained rather less oil, viz. 12·6 per cent. as compared with 17·1 per cent., calculated in each case on the moisture-free material. The oil extracted

from the pericarp resembled that obtained in the previous case and gave similar results on examination.

The kernels of the present sample contained rather more oil than those of the earlier sample, viz. 67·2 per cent. as compared with 64·1 per cent., calculated on the moisture-free material. The oil closely resembled that from the kernels of the previous sample both in appearance and constants except that the amount of soluble and insoluble volatile acids was rather higher.

The composition of the residual meal closely resembled that obtained in the previous investigation.

In view of the similarity in appearance and composition of the present kokerit fruits to those received previously, there can be little doubt that they were derived from the same species of palm.

The pericarp oil from kokerit fruits resembles palm oil in appearance and analytical constants, with the exception of the solidifying point of the fatty acids, which is much higher in the case of palm oil. The high acid value of the oil from the present sample was no doubt due to the fruits having been shipped in a moist condition. This pericarp oil, if available in commercial quantities, would probably realise a price somewhat below that of ordinary palm oil, which is quoted at £35 10*s*. per ton, spot, Liverpool (March, 1927). In view, however, of the comparatively low percentage of oil in the pericarp it seems doubtful whether its extraction on a commercial scale would be remunerative.

The kokerit kernel oil closely resembles palm kernel oil both in appearance and in chemical constants and should be readily saleable in this country as an edible fat at a price approximating to that of palm kernel oil, which is quoted in Liverpool at £37 10*s*. to £38 per ton (March, 1927). As the kernels form only a small percentage of the fruits and nuts (15·3 per cent. of the former and 21·2 per cent. of the latter) it would be necessary to separate the kernels in British Guiana in order to reduce the cost of transport. If the kernels could be delivered whole and in an undamaged condition they would probably realise about the same price as palm kernels, which are quoted in Liverpool at £19 10*s*. per ton, spot (March, 1927).

Some difficulty may be experienced in separating the kernels whole from the nuts as they are easily broken on cracking the very hard shell. It seems possible, however, that the operation could be facilitated by submitting the nuts to steam heat (as is now done in the case of palm nuts to cause the kernels to shrink away from the shells) and then cracking them in a suitable machine. If the kernels could not be shipped in a whole and undamaged condition it would be necessary for them to be crushed in British Guiana.

The residual meal from the kernels is slightly inferior to palm kernel cake as a feeding-stuff, and would probably realise a somewhat lower price than the latter, which is quoted in Liverpool at £7 10s. per ton (March, 1927). If the kernels were crushed in British Guiana it would probably not be profitable to export the cake to the United Kingdom, but a local market might perhaps be found for it.

CAMPHOR LEAVES AND TWIGS FROM ST. LUCIA

An experimental planting of camphor trees (*Cinnamomum Camphora*) was made at the Botanic Station at Reunion, St. Lucia, in 1915, from seedlings raised from seed introduced by the Imperial Commissioner of Agriculture in 1911. The plants made good progress and it was reported in 1923 that the trees were then from 14 to 15 ft. high. At the suggestion of the Imperial Institute a sample of the leaves and twigs obtained from the trees was forwarded by the Agricultural Superintendent in 1925 in order that the yield of camphor might be determined.

It was considered in St. Lucia that the yield and quality of the camphor might vary at different stages of growth and consequently two samples were supplied, viz. No. 1, consisting of young leaves and twigs of 1925 growth, and No. 2, representing ordinary leaves and twigs of 1925 and previous years' growth.

No. 1.—This sample consisted of dried leaves and twigs in the proportion of 1·9 parts of leaves to 1 part of twigs.

No. 2.—Part of this sample was slightly damp and mouldy on arrival and had apparently become wet during transit. On exposing the material to the air for some days,

the mouldy odour disappeared. The leaves and twigs, which were both somewhat browner than those of sample No. 1, were present in the proportion of 2·1 parts of leaves to 1 part of twigs.

On submitting the samples to distillation with steam, sample No. 1, which contained 9·6 per cent. of moisture, yielded 2·8 per cent. of oil, or 3·1 per cent. calculated on the moisture-free material. Sample No. 2, containing 9·1 per cent. of moisture, furnished 2·9 per cent. of oil, or 3·2 per cent. calculated on the moisture-free material.

The oil from sample No. 1 deposited about 70 per cent. of camphor at the ordinary temperature (18° C.). Owing to the small quantity of oil available, the separation of a further quantity of camphor from the residual oil was impracticable.

The oil from sample No. 2 deposited 67·2 per cent. of camphor at the ordinary temperature, and by fractional distillation of the residual oil an additional 7·1 per cent. was obtained. The total amount of camphor obtained from this oil was, therefore, 74·3 per cent.

In the following table these results are compared with those recently obtained at the Imperial Institute with camphor leaves and twigs from Uganda, and with the recorded yields of oil and camphor from camphor leaves from other countries.

Country.	Material.	Yield of camphor.	Yield of camphor and oil.
		Per cent.	*Per cent.*
St. Lucia, Sample No. 1	Air-dried leaves and twigs	approx. 2·0[1]	2·8
St. Lucia, Sample No. 2	Air-dried leaves and twigs	2·2[2]	2·9
Uganda . . .	Air-dried leaves and twigs	1·6[1]	2·3
Tanganyika . . .	Air-dried leaves	1·5	2·0
Jamaica . . .	Air-dried leaves	1·6	2·0
Malay States . .	Air-dried leaves and twigs	—	0·8 to 1·3[3]
Italy	Air-dried leaves	2·4 to 3·0	—
Florida . . .	Green leaves	0·9 to 1·6	1·1 to 2·1
India	Dry leaves (moisture-free)	1·2 to 2·0[4]	—

[1] *Excluding camphor dissolved in residual oil.*
[2] *Including 0·2 per cent. of camphor obtained from residual oil by fractional distillation.*
[3] *Very little oil.*
[4] *Including camphor obtained by the distillation of the residual oil.*

The results of this investigation showed that the two samples of leaves and twigs, although collected at different stages of growth, contained practically the same amount of camphor, which was identical in character. The yields compared very favourably with those recorded for camphor leaves from other sources.

On the basis of these experiments it may be estimated that the air-dried leaves and twigs would yield about 2 per cent. of camphor, and a ton of the material would therefore furnish about 45 lb. of crude camphor, which, at the present price of Japanese crude camphor (about 2*s.* 6*d.* per lb. in London), would be worth £5 12*s.* 6*d.* The present quotation for synthetic camphor is about 2*s.* 9*d.* per lb. in London (March, 1927).

The residual oil, left after the removal of the camphor, was not obtained in sufficient quantity to permit of its complete investigation, but it appeared to be similar in composition to camphor leaf oils from other sources, and would probably find a market at a low price as a turpentine substitute.

The production of camphor from the leaves as a commercial enterprise has been carried out in Florida, where two companies commenced operations some years ago and a few thousand pounds of camphor were prepared and marketed. It seems, however, to have been found impossible to produce the camphor sufficiently cheaply to compete successfully with imported Japanese camphor and the synthetic product, and it was stated in 1922 that the operations had been abandoned.

The question whether the enterprise would prove a profitable undertaking in St. Lucia will require careful consideration, taking into account the present price of camphor and the yield from the leaves, but it seems desirable that the possibilities should be fully investigated. In this connection it may be mentioned that certain essential oils which are now being produced successfully on a commercial scale are obtained in yields similar to that from camphor leaves and are approximately of similar value.

As a rule the twigs contain very little camphor and are not worth distilling, and it would therefore be advisable

in practice to avoid, as far as possible, the inclusion of a large proportion of twigs.

The Imperial Institute offered to conduct any further investigations relating to camphor production in St. Lucia, and stated in this connection that an examination of the leaves and twigs from individual trees could be carried out in accordance with a suggestion made by the Agricultural Superintendent if the necessary material were supplied.

CAMPHOR LEAF OIL FROM BURMA

Plantations of camphor (*Cinnamomum Camphora*) have been made in several parts of Burma, including Upper Chindwin, Myitkyina, Bhamo and Southern Shan States. From information supplied to the Imperial Institute by the manager of a camphor estate in the last-named region it appears that the camphor produced there is at present sold locally, in the crude state, but that the question of preparing a refined product is under consideration. A sample of oil distilled on this estate from the leaves and twigs of the camphor tree, and from which a large proportion of the camphor had been mechanically separated, has been investigated recently at the Imperial Institute in order to ascertain its commercial possibilities in this country.

The sample consisted of two gallons of a pale yellowish-brown oil which was somewhat turbid owing to the presence of moisture. A small amount of camphor had separated from the oil.

On cooling the oil to 0° C. a quantity of camphor (amounting to 5·6 per cent.) separated and was removed by filtration. By submitting the filtered oil to a series of fractional distillations and cooling the appropriate fractions, a further 27 per cent. of camphor was obtained, making the total yield of camphor 32·6 per cent.

The original oil yielded on fractionation about 30 per cent. of light oil boiling up to 195° C. and about 38 per cent. up to 225° C. In the higher boiling fractions a special search was made for the presence of safrole, which is the most valuable constituent of Japanese camphor oil, but it was found that this constituent is either absent or present only in insignificant quantity.

Samples of the original oil were submitted to four firms of essential oil distillers and manufacturing druggists, who all reported that it was of unusual type and that it was not possible to state the price it would be likely to realise in this country. It was considered that its value should be based on the amount of camphor present and that it would probably be saleable for the manufacture of liniments and embrocations.

One firm regarded the value of the oil as about 57*s.* 6*d.* per cwt., whilst another firm was of opinion that it might be worth 9*d.* to 11*d.* per lb. It was generally agreed, however, that the possibilities of the oil could only be ascertained by trials of a commercial consignment, and one of the firms consulted suggested that a quantity of about one ton might be forwarded to test the market.

This camphor leaf oil from Burma differs from the camphor oils which now appear on the market, as the latter contain little or no camphor, whilst the present sample contains as much as 32·6 per cent. The oil furnished on distillation about 30 per cent. of a light oil, consisting principally of low-boiling terpenes and resembling the commercial white camphor oil which is at present quoted in London at 57*s.* 6*d.* per cwt. (March, 1927). The higher boiling fractions of the oil were found to be practically free from safrole and in this respect they differ from the Japanese red camphor oils, the value of which depends chiefly on the safrole present. These higher fractions are not likely to be of any commercial value.

The value of the oil will depend chiefly on the quantity of camphor present, and to a smaller extent on the light oil obtained in the early fractions on distillation.

ACOKANTHERA OUABAIO FROM BRITISH SOMALILAND

The roots, stems and branches of *Acokanthera Ouabaio*, which are the subject of this report, were forwarded for examination to the Imperial Institute by the Secretary to the Administration, British Somaliland, in March, 1926. This plant is one of the sources of the arrow poison used by the natives of North-east Africa.

It was desired to ascertain the nature and amount of the active principle present in the roots and in the stems and branches.

The roots, which were covered with closely adhering bark, varied in cross-section up to about 3½ × 5½ in., most of them being about 1½ to 2 in. in diameter, and ranged in length from a few inches to 2 ft.

The stems and branches, which were also covered with bark, consisted of pieces about 30 in. long and up to 6 × 5 in. in cross-section.

Acokanthera Ouabaio has already been investigated by several chemists, and two poisonous constituents have been isolated, viz. a crystalline glucoside which has been termed ouabain or acokantherin, and an amorphous glucoside variously known as abyssinin, amorphous acokantherin, amorphous ouabain, or acokanthin. Both these substances exert an action on the heart similar to that of strophanthin, and according to Cushny the crystalline ouabain is about twice as active as strophanthin.

The present samples have been examined in order to determine the amounts of crystalline ouabain which they contain. Using the method first employed by Arnaud (*Comptes Rendus*, 1888, p. 1011) a crystalline substance was isolated from both the roots and the stems. The yield and characters of these substances are given in the following table, together with the corresponding results obtained by Arnaud for ouabain.

—	Crystalline substance from present samples. Roots.	Crystalline substance from present samples. Stems and branches.	Crystalline ouabain obtained by Arnaud.
Yield *per cent.*	0·26	0·15	0·3
Melting point . . . °C.	178 to over 200	188–217	180 to about 200
Optical rotation α_D . . .	− 36·5°	− 28·3°	− 34°
Reduction of Fehling's solution after hydrolysis . . .	Positive	Positive	Positive
Solubility in water, cold .	Slightly soluble	Slightly soluble	Slightly soluble
,, ,, ,, boiling . .	Very soluble	Very soluble	Very soluble
,, ,, chloroform . .	Insoluble	Insoluble	Insoluble
,, ,, ether . . .	do.	do.	do.
,, ,, absolute alcohol .	do.	do.	do.

These results indicate that both the roots and the stems and branches of *Acokanthera Ouabaio* from Somaliland yield a fair quantity of crystalline ouabain identical with that isolated by Arnaud.

Ouabain appears to be used to some extent in medicine as a substitute for strophanthin, but it is not at present official in either the British or United States Pharmacopœia.

JUTE FROM HONG KONG

Two samples of jute which had been grown experimentally in the New Territories, Hong Kong, were received at the Imperial Institute for examination in October, 1926. It was desired to ascertain the quality and commercial value of the fibre in connection with the question of establishing a jute industry in the Colony. The following particulars relating to the samples are taken from a report by the Superintendent of the Botanical and Forestry Department which has been furnished to the Imperial Institute.

The seed was sown broadcast in March and the plants harvested as they began to flower during the first week in August. At this time about 20 per cent. of the plants were 7 ft. 6 in. in height and the remainder between 5 and 6 ft.

Sample No. 1 was grown in old flat grass land which was ploughed to a depth of not more than 18 in., a light dressing of pig manure being then added but no further application of manure made.

Sample No. 2 was grown on land formerly used as rice fields. The soil in this case was dug with spades to a depth of 2 ft., and no manure was applied.

After harvesting, the plants were exposed to the sun for from 2 to 4 days in order to dry up the foliage. The plants were then retted by immersion in still water (in tanks or ponds) for approximately 20 days, and the fibre washed in running water before being finally dried.

The samples, as received, were as follows:

No. 1.—This consisted of four bundles of soft, clean, lustrous, well-prepared jute, varying in colour from light brown to pale cream. The fibre varied in length from

3 to 4½ ft., being mostly about 3½ ft., and was of good strength.

No. 2.—This consisted of two bundles of fibre which was very similar to No. 1, but slightly weaker.

Both the samples were rather less soft and lustrous than the finest grades of Indian jute.

On chemical examination the samples furnished the following results in comparison with the corresponding figures obtained for a sample of "extra fine" Calcutta jute examined at the Imperial Institute.

	No 1	No. 2	"Extra fine" Calcutta jute
	Per cent.	*Per cent.*	*Per cent.*
Moisture	10·6	10·1	9·6
Calculated on moisture-free material:			
Ash . .	0·7	0·5	0·7
α-Hydrolysis loss	7·9	8·4	9·1
β-Hydrolysis loss	13·2	12·0	13·1
Acid purification loss	1·3	1·8	*
Water washing loss	0·5	0·8	*
Cellulose .	78·3	76·1	77·7

* *Not determined.*

These results indicate that the present samples of fibre from Hong Kong are of good quality and compare very satisfactorily in chemical characters and composition with Indian jute of good quality.

The samples were submitted to Messrs. Wigglesworth and Co. Ltd., for commercial valuation. They reported that No. 1 had been somewhat irregularly cleaned, but was otherwise of good quality. No. 2 was regarded as of rather better colour than No. 1 and had been satisfactorily prepared except that the root ends were rather harsh. The firm stated that fibre of both qualities would be saleable in large quantities in this country at prices of £32 and £34 per ton respectively, with "first marks" Calcutta jute at £30 per ton.

These samples of jute from Hong Kong are of good quality and compare satisfactorily with Indian jute although they are shorter and not so soft and lustrous as the best qualities of the latter. Such material, if produced in commercial quantities, would find a ready market in this country.

ARTICLES

THE DEVELOPMENT OF BAST AND LEAF FIBRE CULTIVATION IN THE BRITISH EMPIRE[1]

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Introduction

Bast and leaf fibres form an important class of economic products, the bast fibres including the useful textile fibres, flax, hemp, jute and ramie or China grass, and the leaf fibres the cordage materials, Manila hemp, Sisal hemp, Mauritius hemp and New Zealand hemp.

The aim of this paper is to give a brief review of the industries concerned with the production of these fibres in countries of the British Empire and to indicate their development, their present position and the possibilities of extension. Incidentally reference will be made to a number of other fibres which in certain cases might serve as substitutes for these better-known materials.

Before dealing with the subject in detail, it may be of interest to enumerate the industries actually in existence. It is clear that within the British Empire there are very few large industries of this kind. By far the greatest is of course the old-established jute industry of India with an annual output of more than one-and-a-half million tons of fibre produced on an area of over three million acres. The remaining industries fall into three groups. Those of the first group, instead of yielding annually millions of tons of fibre, produce only tens of thousands; they include the cultivation of Sisal hemp in East Africa (Kenya and Tanganyika), the production of Bombay or Sunn hemp in India, the New Zealand hemp industry, and the Irish flax-growing industry. The second group comprises some comparatively small industries with a production of between one hundred and two thousand tons, viz. flax-growing in Canada, Sisal hemp cultivation in the Bahamas, Jamaica, Nyasaland, Gold Coast and Ceylon, the production of Furcraea fibre (Mauri-

[1] A Public Lecture delivered to the London Section of the Textile Institute at the Clothworkers' Hall on February 7, 1927. Printed by courtesy of the Editor of the *Journal of the Textile Institute*.

tius hemp) in Mauritius and Natal, and of Phormium fibre (New Zealand hemp) in St. Helena. Finally there are industries which at present have scarcely developed beyond the experimental stage, such as the production of flax in Cyprus and of hemp in Canada.

It is hoped that the facts presented will lead to a realisation of the great extent to which fibre production might be increased in countries of the British Empire if the necessary enterprise and capital were forthcoming.

PART I

Bast Fibres

Flax

In dealing with the bast fibres, we will first consider flax, the product of the linseed plant (*Linum usitatissimum*). As is well known, the cultivation of this plant for fibre is almost entirely restricted to the Continent of Europe, with the exception of Asiatic Russia and the comparatively small areas in Ireland and Canada. The only parts of the British Empire in which flax is being, or has been, grown in commercial quantities, in addition to the British Isles and Canada, are Australia, Kenya Colony and Cyprus.

British Isles.—Flax-growing is a very ancient industry of the British Isles. There is little doubt that the plant was introduced by the Romans, but whether they actually cultivated it on an industrial scale seems open to question. In the middle ages, flax was grown in all parts of the country and the fibre was manufactured into linen to meet local requirements. In 1533, a statute was enacted which ordained that for every sixty acres of land brought under cultivation one rood must be sown with either flax or hemp. In 1783, bounties were paid by the government to encourage flax production.

Flax cultivation continued to be a fairly large industry in all parts of the British Isles until the beginning of the nineteenth century, but then gradually declined in Great Britain owing to the growing scarcity of labour caused by the movement of the rural population into the towns and the importation of cheap flax from Russia. In 1842, a duty was imposed on imported flax but was withdrawn in

1845. About the year 1850 an attempt was made to resuscitate the industry in Great Britain but this was defeated by the increased price of corn and its consequent greater value as a farm crop. The production of the fibre revived to some extent during the American civil war (1861–64) owing to the scarcity of cotton. In 1870, the flax plant was grown on the maximum recorded area of 23,957 acres, of which about one-half was grown for fibre and the remainder for linseed. From this time the cultivation rapidly diminished until in 1901 only 640 acres were devoted to the crop.

Regarding the efforts which were made just before and during the Great War to develop the cultivation of flax in Great Britain, it will be sufficient to mention the formation of the British Flax and Hemp Growers' Society in 1912, and the establishment of the experiment station at Selby by the Leeds University at about the same time. In 1917 these efforts were combined under the Flax Production Branch of the Board of Agriculture and considerable areas were planted in Somerset and Dorset, Yorkshire, Lincolnshire, Suffolk and Fifeshire, the total area in 1918 amounting to 13,537 acres. Twelve factories were established for retting and scutching the fibre and vigorous efforts were made to increase the popularity of the crop. With the end of the war the urgent need for flax production ceased, the price of the fibre fell and the area under cultivation rapidly diminished. Of the twelve Government factories only two remain. These are now being run by the Flax Industry Development Society which has its headquarters at Yeovil in Somerset and plants 1,000 acres or more each year. The Society operates on a purely commercial basis and is working in collaboration with the Linen Industry Research Association. Improved varieties of flax are being produced experimentally by the Association and these are grown on a large scale by the Flax Industry Development Society in order to obtain pedigree seed for distribution in Ireland and other parts of the Empire.

Before leaving the subject of flax-growing in Great Britain it may be mentioned that quite recently it has been announced that a new scheme is being launched for again

attempting the cultivation in the neighbourhood of Selby in Yorkshire and that a crop is to be planted next season.

In the year 1850 when flax-growing in Great Britain was at a very low ebb, the industry was comparatively flourishing in Ireland where about 91,000 acres were under cultivation. The area gradually increased and in 1860 had attained to 128,000 acres. In 1864 during the American Civil War a remarkable development took place and the record area of 301,693 acres was devoted to the crop. This phenomenal increase, like that during the same period in Great Britain, was due to the absence of supplies of cotton from America and the partial substitution of flax for it. It was found, however, that the machinery and factories required to spin and weave the fibre could not be produced sufficiently quickly to deal with such a suddenly augmented output, and the cultivation underwent a rapid decline until in 1898 the area amounted to only 34,469 acres. Some improvement then took place, the average annual acreage being 48,064 during 1901–5, 49,169 during 1905–10 and 56,676 during 1911–15. Meanwhile the Irish flax-spinning industry had undergone great expansion and in the year immediately preceding the Great War only about a quarter to one-fifth of the fibre required in the mills was produced in the country, the remainder being imported, chiefly from Russia and Belgium. The reduction in the supplies from Europe which was occasioned by the war led to the cultivation of an increased area which amounted to 91,454 acres in 1916, 107,705 acres in 1917, and 143,355 acres in 1918, an area which was only exceeded by the record figure of 1864.

Since the war the area devoted to flax in Ireland has fallen to approximately that cultivated during the years 1901–15, the average for the three years 1923–25 being 50,825 acres; the average annual production of fibre during the same period amounted to 7,716 tons.

Kenya Colony.—The first attempts to grow flax in East Africa were made in 1908 at the Kabete Government Experiment Farm in the Highlands about seven miles from Nairobi and at a height of 5,600 feet above sea-level. A sample of the first year's crop which was forwarded to the Imperial Institute for examination appeared to have

been injured by over-retting, but the result of the experiment was regarded as sufficiently encouraging to justify further trials. An active interest was taken in the project by Messrs. Wigglesworth and Co., and in 1911 they erected their first flax mill in the Colony. In 1913, the services of a flax expert from Courtrai, Belgium, were secured and it was proved that flax of a high quality could be produced. In 1918 the area devoted to flax in Kenya amounted to about 8,000–9,000 acres and in each of the years ending June 30, 1920, and June 30, 1921, about 25,000 acres were harvested. Subsequently the industry became less popular; in 1924 the area under the crop was little more than 3,000 acres and in 1925 it fell to 552 acres. At the present time flax-growing has almost disappeared. The unfortunate decline of the industry was due to the fall in the price of flax, to the high cost of production caused by the increasing cost of labour, and to the difficulty of obtaining a sufficient labour supply for harvesting and retting. The experience gained during the brief life of the industry has definitely proved that flax of excellent quality can be grown in the Kenya Highlands, but that under present conditions its production is not remunerative.

India.—Although the flax plant is cultivated in India it is grown almost entirely for the production of linseed. It has been abundantly proved that flax can be grown successfully in certain parts of India, especially in the Punjab and United Provinces. Important experiments were carried on in Bengal between 1790 and 1820. In 1839 a Company was formed for developing flax cultivation in India, and the services of Belgian experts were secured. The experiments were extended throughout India, those in the United Provinces, Punjab, Madras and Bombay being conducted under Government supervision. In spite of all these efforts the hoped-for results were not realised. Again in 1854 the Government induced the natives in the Punjab to cultivate 250,000 acres of flax. It is stated that the enterprise proved profitable to the growers and yielded a fibre of fair average quality. Nevertheless the flax industry lapsed about 1865, but the cultivation of the plant for linseed continued on a very large scale.

A renewed attempt to grow flax in India was undertaken

Flax Growing

PLATE II.

FIBRE CULTIVATION IN THE EMPIRE.

CUTTING JUTE.

CUTTING JUTE UNDER WATER.

in 1906 by the Bihar Planters' Association. Preliminary experiments were found to justify extended trials and in 1907 the Bengal Government engaged the services of a Belgian flax expert. These trials, which were carried out at Dooriah, succeeded in producing flax of good quality and gave a good return on the capital invested. The enterprise was subsequently abandoned, however, for the following reasons. The experiments were chiefly carried out with a view to the establishment of flax as a subsidiary industry among the Bihar indigo factories (where indigo cultivation had been much reduced owing to the competition of the synthetic indigo manufactured in Germany) and the necessary masonry vats were thus available for flax retting. On the revival of a demand for natural indigo the planters returned to indigo cultivation and abandoned flax-growing. Further difficulties arose in connection with the low percentage of fibre obtainable from the flax straw and the uncertainty of securing satisfactory germination of the seed when sown on land dependent on the rainfall for its moisture.

Flax was also successfully grown at the Cawnpore Experiment Farm during the years 1913–17, good yields being obtained without manuring or any particularly high cultivation. These experiments proved that flax could be produced in the United Provinces with very profitable returns, but planters have not shown any inclination to embark in this enterprise. The establishment of such an industry would require the provision of central factories and sub-stations for retting, scutching and preparing the flax for the market, operations which could not be performed by small cultivators in villages. It seems improbable, however, that any large flax industry will be established in India in the near future, especially in view of the disinclination of the Indian peasant to turn his attention to crops with which he is not familiar. He has no incentive to grow flax instead of linseed while the latter provides him with a good profit.

Canada.—The flax plant has long been grown in Canada on a very large scale for the production of linseed, but only on comparatively small areas as a source of fibre. In 1916 the Canadian Government endeavoured to

promote the flax-growing industry, and a flax and fibre expert was appointed and attached to the Department of Agriculture with the object of discovering the localities best suited to the crop and of improving the methods of planting and preparation then employed in the Dominion. These efforts resulted in an area of 20,000 acres being planted in 1918 in the Eastern Provinces, especially Ontario. In 1919 the area devoted to flax in Canada amounted to 20,262 acres and in 1920 to 31,300 acres. Owing to the great fall in the price of flax which then took place only 6,515 acres were sown in 1921 and still smaller areas were planted in subsequent years. In 1925 the area amounted to 6,200 acres, entirely in the province of Ontario.

The maximum production was obtained in 1920 and amounted to 3,320 tons of fibre and 1,860 tons of tow. In 1924 the output was only 800 tons of fibre and 19 tons of tow.

During the war the Department of Agriculture made special provision for the inspection and grading of the flax seed in order to maintain a uniform standard of purity and quality of seed, and, in 1919, 90,000 bushels of inspected seed were shipped to Ireland.

Australia.—Flax is cultivated on a small scale in Victoria where there is a large area of land well suited to the crop. Several efforts have been made to grow flax in New South Wales and Tasmania but without much success. Further proposals have recently been made for the development of a flax-growing industry in Tasmania and consideration is now being given to the possibilities of producing the fibre in Western Australia.

In 1907 an act was passed which provided for a Government bounty amounting to 10 per cent. of the market value of the crop, but this did not stimulate flax-growing to any great extent. In 1918 the Commonwealth Government formed a Commonwealth Flax Industry Committee for the development and control of the industry, and offered to purchase dew-retted flax at £170 per ton, with additional bonus of £5 per ton for fibre of a specified standard. In 1919 the bonus was increased to £6 per ton. As a result of this action, the area devoted to the crop in Gippsland,

Victoria, where flax has been grown on a small scale for the last quarter of a century, increased in 1918 to 1,500 acres and in 1919 to 2,200 acres. Smaller areas were planted in the next three years and in the year 1923–24 no flax was sown, but the Commonwealth Flax Industry Committee, which has since been wound up, supplied seed to firms for sowing in the 1924–25 season and 130 acres were planted.

Cyprus.—The flax plant appears to have been cultivated in Cyprus from very early times, but until comparatively recently it has been grown mainly as a source of linseed. In 1923 an effort was made to induce the villagers to undertake the production of the fibre on a commercial scale and a Russian flax expert was employed by the Agricultural Department to assist in the development of the industry. Rapid progress has been made and three scutching factories have been established which are turning out flax of very good quality. It is hoped that two more factories will be erected in the near future. The first scutching factory was equipped by the Government and then handed over to a Co-operative Society which undertook to repay the cost. The flax expert was appointed as Secretary of the Society and has since directed the work of the factory. In 1924, 6 tons of Belgian seed were sown and excellent results were obtained, and the fibre realised very good prices both in Ireland and Scotland. In 1925 no less than 20 tons of Belgian seed were sown, and although the crop suffered owing to the scarcity of rain, 114 tons of scutched flax were prepared for shipment. It is considered that the results so far achieved are highly satisfactory and it is anticipated that in a few years flax production will be an important industry in the island.

Other Countries.—Trials have recently been made to cultivate flax in the West Cape Province of the Union of South Africa and are stated to have given good results. In 1923 the crop was grown on 14 farms with a total area of about 600 acres.

Experiments have also been carried out in Uganda and in Palestine and Iraq, and specimens of the fibre produced have been examined at the Imperial Institute and found to be of promising quality.

Hemp

The name "hemp" has been applied to several fibres which differ widely from true hemp and this has led to much confusion, especially in statistical returns, in which it often happens that no descriptive prefix is attached. Among the commoner fibres designated as hemp may be mentioned Bombay, Sunn or San hemp, to which reference will be made shortly, Deccan or Ambari hemp (a jute-like fibre derived from *Hibiscus cannabinus*), Manila hemp, Sisal hemp, Mauritius hemp and New Zealand hemp. The fibre now to be considered is true hemp, the bast fibre of the stem of *Cannabis sativa.*

Hemp is cultivated for fibre in most European countries, and also in China, Japan and the United States, but very little hemp is produced within the British Empire although the plant occurs in India, in both East and West Africa, and in other countries. In hot countries, the stalks, leaves and flowers produce a resinous juice, possessing properties which render it one of the most characteristic narcotics of Eastern lands. The drug is known under various forms, such as "charas," the resin itself; "ganja," the dried flowering tops of cultivated female plants; "bhang," the dried leaves and flowering shoots of either or both the male and female plants, and "hashish," a Turkish preparation of the leaves. Owing to the dangers arising from the use of the plant as a narcotic, its cultivation has been prohibited in some countries; for example, in Kenya Colony and Protectorate, under an ordinance for the suppression of the abuse of opium and certain opiates, rules were made in 1914 enacting that no person may sow, cultivate or otherwise grow hemp in the country.

British Isles.—The introduction of hemp into the British Isles is of very ancient date and is supposed to have been due to the Romans. As in the case of flax, its cultivation was made compulsory in 1533 and the crop appears to have been grown somewhat extensively at that time, but the industry subsequently declined. In 1787, a Government bounty was allowed on all hemp grown in England and a duty was levied on imported hemp. This action appears to have caused some revival of the cultivation, but afterwards it rapidly diminished again. Between 1850 and 1860 hemp

was grown to a limited extent in the fen country of Lincolnshire and Cambridgeshire and also in Yorkshire, but the industry gradually languished owing to the same causes which led to the abandonment of flax cultivation. Suggestions for the resuscitation of hemp-growing have been made from time to time and trials have been made on several occasions, but without any permanent result.

Cyprus.—Hemp is grown in Cyprus in the southern part of the Paphos district in areas well supplied with water. The fibre is used by the natives for making ropes, but it has not been produced for export.

Canada.—In view of the large expenditure incurred in the West of Canada for binder twine, attempts have been made to produce the fibre in the Dominion. The first experiment was made in 1915, but the result was unsatisfactory owing to damage caused by storms. Since the war, trials have been made by the Development Branch of the Canadian Pacific Railway in conjunction with the Federal Department of Agriculture and have shown that the irrigated lands of Southern Alberta are well suited to the crop. In 1925, the experiments gave very good results, the hemp being described by experts as a " bumper crop of exceptional quality." Trials have also been carried out in Manitoba, and in 1925 about 563 acres were sown in addition to numerous small plots grown by farmers for their own requirements. It is hoped that industrial manufacture will be started this year and that a gradual diminution of the imports of hemp products will be effected.

India.—In India the hemp plant has been extensively cultivated and used mainly for the preparation of the narcotic drugs already mentioned. It is, however, cultivated as a source of fibre in the North-West Himalayas and to a small extent in Sind.

Sunn Hemp

The so-called hemp which forms an important raw product in Indian commerce is not derived from the true hemp plant, but is the bast fibre of the stems of *Crotalaria juncea,* a leguminous plant which is probably indigenous to the country. The fibre is known under the names of

Bombay hemp and Sunn or San hemp, and from the time of the East India Company onwards attempts have been made to establish it as a substitute for Russian hemp. The plant is now grown widely in Bombay, the Central Provinces and the United Provinces. Large areas are also devoted to the crop in the Madras Presidency, where it is grown for use as fodder as well as for the production of fibre. In the year 1890–91 the total exports were only 2,816 tons, but they gradually increased and in 1903–4 reached 23,865 tons and in 1907–8, 32,930 tons. During the last ten years (1916–17 to 1925–26) the average annual exports have amounted to about 25,000 tons. Up to the year 1920 the greater part of the exports were sent to the United Kingdom, but since that time the direct imports into the United Kingdom have decreased owing to London having been displaced to some extent by Antwerp as a distributing market. In the year 1925–26, 301,874 cwts. were exported to Belgium as compared with 103,766 cwts. to the United Kingdom.

Sunn hemp is used chiefly as a substitute for the lower classes of European hemps, especially Russian hemp, but some of the Bengal product is of sufficiently good quality to be suitable for mixing with Italian or Hungarian hemp.

Much of the Sunn hemp produced for the market is of inferior quality owing to insufficient retting of the stalks and lack of care in preparing and grading the fibre. In many cases the colour and strength are deteriorated by the defective methods of retting employed, such as the use of muddy stagnant water in village ponds and the ignorance of proper methods on the part of the cultivator. Perhaps the chief objection of spinners to Sunn hemp is that it is often coated with mud or clay which causes considerable annoyance in the mills and necessitates the installation of elaborate dust extraction plants. The attention of the Indian authorities has been repeatedly drawn to these defects and efforts are now being made to ensure the production of a better and cleaner fibre. It is unlikely that the demand for the fibre will undergo any great extension until such improvements have been effected.

Sunn hemp is also grown in the coastal areas of Ceylon,

especially in the Northern part of the Colony. It is at present used locally for the manufacture of fishing nets, and it is probable that its production could be extended.

Jute

Jute is by far the most important bast fibre produced in the British Empire. It is derived from two species of plants, *Corchorus capsularis* and *C. olitorius*, and is produced almost exclusively in India. The greater part of the crop is grown in Bengal. Of the 3,629,994 acres estimated to have been planted in 1926, no less than 3,170,554 acres were in Bengal (including Cooch Behar and Tripura States), whilst 280,440 acres were in Bihar and Orissa and 179,000 acres in Assam.

The early history of jute is buried in the remote past. The fibre was used by the natives of Bengal for making cordage and gunny cloth long before its introduction into European industry, the cloth being woven by means of hand-looms. The first shipment of jute is stated to have been made in 1795, but the recorded exports in 1828 were only 364 cwts. In Great Britain, attention was directed to the fibre at the end of the eighteenth century and early in the nineteenth century it was spun and woven in Abingdon. Small quantities continued to be imported for several years, but it was not until 1832 that the utilisation of the fibre acquired any great importance. In the year 1832–33 the exports from India rose to 11,800 cwts. About this time Dundee spinners began to manufacture jute fabrics on power looms and this led the way to the development of an enormous industry. The growth of this industry was stimulated by the Crimean War of 1854–55 owing to the diminution in the supply of Russian flax and hemp, and the exploitation of jute as a fibre of the first importance dates from that time.

The progress made in Dundee in spinning and weaving jute by means of machinery led to the introduction of mills into the neighbourhood of Calcutta and from that time the Indian jute manufacturing industry has steadily increased. The magnitude of this Indian industry may be gauged by the fact that there are now about 90 mills in operation, employing over a million spindles, about 50,000

looms, and providing work for between 300,000 and 400,000 people.

The average area devoted to jute in India is approximately 3 million acres and the annual production amounts to about 1½ million tons. The estimated production in 1925 and 1926 was 1,607,143 tons and 1,765,875 tons respectively.

In pre-war times the quantity of raw jute exported was nearly equal to the amount consumed in the Indian mills, but now only about one-third of the crop is exported and two-thirds consumed. In the year ending March 31, 1926, the total exports of jute amounted to 647,154 tons, of which 174,404 tons were shipped to the United Kingdom.

Experiments have been conducted for many years by the Agricultural Department of Bengal to improve the crop, especially by the development of new races by selection and hybridisation. Several races have been obtained which are decidedly above the average in respect of both yield and quality, and large quantities of the seed of these races is annually supplied to cultivators. It has also been shown that the yield could be largely increased by the application of manure to the soil.

During the last five or six years, experiments have been carried out in the United Provinces and have shown that very fair yields can be obtained in that area if suitable land is selected for planting and the crop is carefully cultivated, especially in the early stages of growth. The area planted in 1925 exceeded 1,800 acres, and it is anticipated that jute cultivation will undergo rapid extension.

Many experiments have been made with jute in other countries of the Empire than India, but without any permanent result. The chief difficulties which have been encountered are (1) a lack of water for retting, and (2) the cost of labour, which is usually too high for the fibre to be obtainable at a price comparable with that of Indian jute.

In 1896, large quantities of jute seed were forwarded to West Africa and distributed to several places on the Coast. The experiments demonstrated that jute of good quality could be produced in the country, but they were on too small a scale to show whether a successful industry

could be established. In 1905, in consequence of the increasing utilisation of jute in the Indian mills and the consequent difficulty experienced by the jute spinners of Dundee in obtaining adequate supplies of their raw material, the Dundee Chamber of Commerce endeavoured again to introduce jute cultivation into British West Africa. Early in 1906, arrangements were made by the Colonial Office with the Government of India for a supply of Indian jute seed for distribution in the West African Possessions, and a Memorandum on the cultivation and preparation of the fibre, drawn up by the Inspector-General of Agriculture, was communicated to these countries. Trials were carried out in several parts of West Africa and, although in some cases it was found that the plants would grow satisfactorily, it was considered that, in general, the cost of production would be too great for the crop to prove remunerative.

Experiments in jute cultivation have also been made in the Sudan, Rhodesia, South Africa and Fiji, and trials are now being made in the New Territory, Hong Kong. Specimens of the fibre produced in all these countries have been received and examined at the Imperial Institute and reports on many of them may be found in the pages of the *Bulletin of the Imperial Institute.*

Jute Substitutes

There are numerous plants, particularly of the natural orders Malvaceæ and Tiliaceæ, which yield bast fibres similar to jute and capable of being spun as a substitute for it or in admixture with it. Among the more important of these are species of Abutilon, Hibiscus, Sida, Triumfetta and Urena.

The most important species of Abutilon is *A. Avicennæ*, which is cultivated extensively in China and yields the fibre which enters the market under the name of "China-jute." Other species, viz. *A. asiaticum* and *A. indicum*, occur in India and also in parts of West Africa, and yield fibres which are of similar character to "China jute," but have not been produced on commercial lines.

The only jute substitute which is regularly grown in the British Empire on an industrial scale is *Hibiscus*

cannabinus. This plant is cultivated largely in Madras and to some extent in Bombay, and occasionally in the Central Provinces. The fibre is known in commerce as " Bimlipatam jute " after the name of the port from which it is chiefly shipped, and is also referred to as " Deccan hemp " or " Ambari hemp." The exports of jute from Madras, which consist mainly or entirely of this fibre, have varied enormously, the highest figure recorded during recent years being 22,003 tons in 1913–14, whilst the average annual exports during the five years 1921–22 to 1925–26 were only 3,034 tons. In 1925–26, 6,537 tons were shipped. The irregularity in the trade is due to the fact that a large part of the crop is consumed in the Madras mills and only the surplus is exported. Bimlipatam jute is somewhat coarser than true jute, but can be used for most of the purposes to which jute is ordinarily applied. Considerable attention has been devoted to the plant in India during recent years and improved races have been established.

In the warmer parts of the Transvaal and Natal *Hibiscus cannabinus* grows wild and is known as the " wild stock rose." It is regarded as a pest in the maize fields, where its presence interferes seriously with the crop. A few years ago, a small company was formed for the purpose of cultivating the Hibiscus plant and establishing an industry in the fibre. About 200 acres were planted, and efforts were made to encourage the farmers to grow the crop. The erection of spinning mills was contemplated with a view to the manufacture of maize bags, whilst any surplus fibre was to be exported. It seems, however, that the enterprise was not successful.

Hibiscus cannabinus also grows in many other countries of the Empire, and specimens of the fibre from the Sudan, Gold Coast, Rhodesia and Iraq have been examined at the Imperial Institute.

There are a number of other species of Hibiscus which yield jute-like fibres. They grow in many British countries and are commonly employed by the natives for rope-making and other purposes. Several of the fibres have been examined at the Imperial Institute and reports on them may be found in the Institute's publications. Refer-

ence may be made in particular to *Hibiscus quinquelobus*, a plant known in Sierra Leone as "Kowe" or "Corwey," and sometimes referred to as "West African jute." Owing to the facility with which the fibre can be prepared, it received considerable attention about twenty years ago, and a small export trade was developed during the temporary jute shortage in the years 1904–5. It was found, however, that although the fibre can be used for spinning in admixture with jute, spinners do not care to purchase it when ample supplies of Indian jute are obtainable at a reasonable price.

During the last three or four years, a good deal of attention has been given to the possibilities of the product known as "Roselle fibre," the bast fibre of another Hibiscus, viz. *H. Sabdariffa* var. *altissima*. Trials have been made with this plant in the Federated Malay States and in Ceylon and have given promising results. In the latter country it has been shown that the fibre is obtainable in good yields, and a sample examined at the Imperial Institute, although rather coarser and less lustrous than Calcutta jute, was found to be of good strength and likely to prove durable.

Species of *Sida* occur in India and in both East and West Africa and specimens of fibre from India, West Africa and Nyasaland have been examined at the Imperial Institute. In 1912 and 1913, small consignments of *S. rhombifolia* fibre were received from India. The fibre was fine, soft, very lustrous and of excellent quality, and it was considered that if produced in commercial quantities it would realise a price about 10 to 20 per cent. in advance of "first marks" Calcutta jute. In spite of this, however, it is improbable that Sida would repay cultivation since trials carried out by the Department of Agriculture in Bengal showed that it gives a smaller yield per acre than jute and that the fibre is more troublesome to prepare owing to the interior of the stem being soft instead of hard and woody.

Species of *Urena*, although of common occurrence in India and in various parts of Africa, do not appear to have ever been grown on a large scale within the Empire. The fibre of *Urena lobata* has been produced in commercial quantities in Brazil, in Madagascar and in Cuba. Trials

have been carried out with this species in India, and samples of the fibre examined at the Imperial Institute were fine, soft, lustrous and of excellent spinning quality.

Ramie

Ramie is not at present grown on a commercial scale in any part of the British Empire, but as it has been the subject of numerous trials some reference must be made to it. This fibre, also known as rhea and China grass, consists of the bast tissue of the stem of *Boehmeria nivea*, a plant of the natural order Urticaceæ or nettle family. The plant grows to a height of from 4 to 8 feet and somewhat resembles the common nettle, *Urtica dioica*, but is devoid of stinging hairs.

It has been found that the ramie plant will thrive in most of the sub-tropical and tropical countries of the British Empire, and that its cultivation offers little difficulty. In spite of this, however, the industry has not made any progress in other countries than China owing to the fact that ramie spinners in this country, and probably also on the Continent of Europe, will not purchase the fibre unless it is in the form of hand-cleaned China grass. The spinners degum this product by chemical methods which they have developed in their own factories and which would require modification if the fibre were received in any other condition. In this respect the preparation of ramie fibre differs from that of all the bast fibres previously mentioned, as these are invariably extracted by retting methods.

The hand-cleaned China grass is prepared in China by a tedious process which can only be employed when very cheap labour is available. The bark is stripped from the stems and the outer skin is removed by scraping and washing, some of the gummy material encrusting the fibre being extracted during the process. Only a few pounds of fibre are obtained as the result of a day's work. The gummy matter still remaining in the fibre is removed by the spinner, as already mentioned, in order to obtain the clean lustrous filasse. The British ramie spinners obtain the whole of the ramie they require from China, and experience no difficulty in securing ample supplies.

Enormous quantities of ramie are produced in China, a large proportion of which is used in that country whilst most of the remainder is exported to Japan, comparatively small quantities being shipped to European countries. The imports of ramie into the United Kingdom in 1925 amounted to 465 tons, of which 447 tons were received from China, 12 tons from other foreign countries and 6 tons from British possessions. From these and other data it appears that almost the whole of the ramie fibre entering the world's markets is at present derived from China.

It is evident that a product similar in appearance and quality to hand-cleaned China grass could not be profitably produced in any British Colony unless the preparation could be effected by machinery. Apparently, however, no machine has yet been placed on the market which is capable of carrying out the work to the satisfaction of the spinner. There is therefore little likelihood at present of the development of a ramie-growing industry within the British Empire.

(Part II—Leaf Fibres—will appear in the next issue.)

A PRELIMINARY ACCOUNT OF THE TIN DEPOSITS OF NORTH-WESTERN KARAGWE (TANGANYIKA TERRITORY) AND SOUTHERN ANKOLE (UGANDA PROTECTORATE)

(With a Geological Sketch-map)

THE following is an abstract of a report by A. D. Combe, Field Geologist, submitted to E. J. Wayland, Director of the Geological Survey of Uganda. A detailed report on the geology of this region is in course of preparation and this abstract is authorised by the Colonial Office, pending publication of the detailed report. The original report and accompanying maps may be consulted on application to the Director of the Imperial Institute.

The report is divided as follows:

General Statement.

A short summary of the Geology of the Cassiterite-Bearing Areas.

The Cassiterite Deposits.
- I. North-western Karagwe.
  - 1. The Kyerwa Deposits.
  - 2. The Ibanda Deposits.
- II. Southern Ankole.
  - 1. The Kikagati area.
  - 2. The Ntundu area.
  - 3. The Ruzinga area.
  - 4. The Naniankoko area.
  - 5. The Dwawanga area.

General Summary.
Transport Facilities and Supplies.
- I. Transport Facilities.
  - 1. North-western Karagwe.
  - 2. Southern Ankole.
- II. Timber, Fuel and Water Supplies.

GENERAL STATEMENT

Rich deposits of cassiterite were discovered in north-western Karagwe about the middle of 1924 and attracted the attention of prospectors, with the result that further deposits were discovered in neighbouring areas on both sides of the Uganda-Tanganyika boundary. The whole of the area situated within the confines of the Western Province of Uganda has been taken up under exclusive prospecting licences.

The cassiterite-bearing areas are (*a*) Kyerwa and (*b*) Ibanda, in north-western Karagwe, and (*a*) Kikagati-Ntundu, (*b*) Ruzinga-Naniankoko and (*c*) Dwawanga in southern Ankole. The following descriptions are based on observations made in March, 1925, in the case of Karagwe, and in March, 1926, in the case of southern Ankole.

All the deposits of tinstone known up to the present occur in the more metamorphosed rocks of the Karagwe-Ankolian System, either along or adjacent to lines of contact with large granite intrusions. The cassiterite occurs in quartz reefs and veins, in small pegmatitic veins, in detrital and eluvial deposits and in alluvial deposits.

THE GEOLOGY OF THE CASSITERITE-BEARING AREAS

The most important formations in these areas are rocks of the Karagwe-Ankolian System and intrusions of coarse-grained porphyritic muscovite-biotite granite and associated rocks.

The rocks of the Karagwe-Ankolian System comprise a great thickness of ancient unfossiliferous sediments, in part metamorphosed, including sandstones, quartzites, shales, slates, phyllites and mica-schists. Shales and their metamorphosed equivalents form the greater part of the System in the areas concerned. In some areas, notably in southern and south-western Ankole, the Rukiga Mountains (situated within the Kigezi Administrative District) and north-western Tanganyika Territory, the rocks can be divided into two well-marked and distinct divisions, provisionally termed the Upper and Lower Divisions of the Karagwe-Ankolian System, the dividing line being placed at the base of a very thick quartzite bed situated about half way up from the known base of the System. Such hard quartzite beds are prominent features in Ankole and Karagwe, and in some cases are as much as 3,000 feet thick. They form persistent horizons over great distances and greatly facilitate the working out of the complex structures into which the beds have been folded.

The shales, where unaltered, generally consist of thinly bedded types of various colours and are composed of very fine argillaceous, siliceous and micaceous material. They contain coarser sandy material in some places and pass into argillaceous sandstones. Over wide areas their original character has been entirely obliterated as the result of folding and contact metamorphic effects set up by the intrusions of the granites. The areas and belts of foliated mica-schists are found along and adjacent to the line of contact with the granite intrusions from which the cassiterite has been derived.

The quartzites consist dominantly of fine to medium grade types, white to blue in colour. The blue quartzites are usually very dense and hard and give rise to most of the continuous, rough and magnificent strike ridges in the

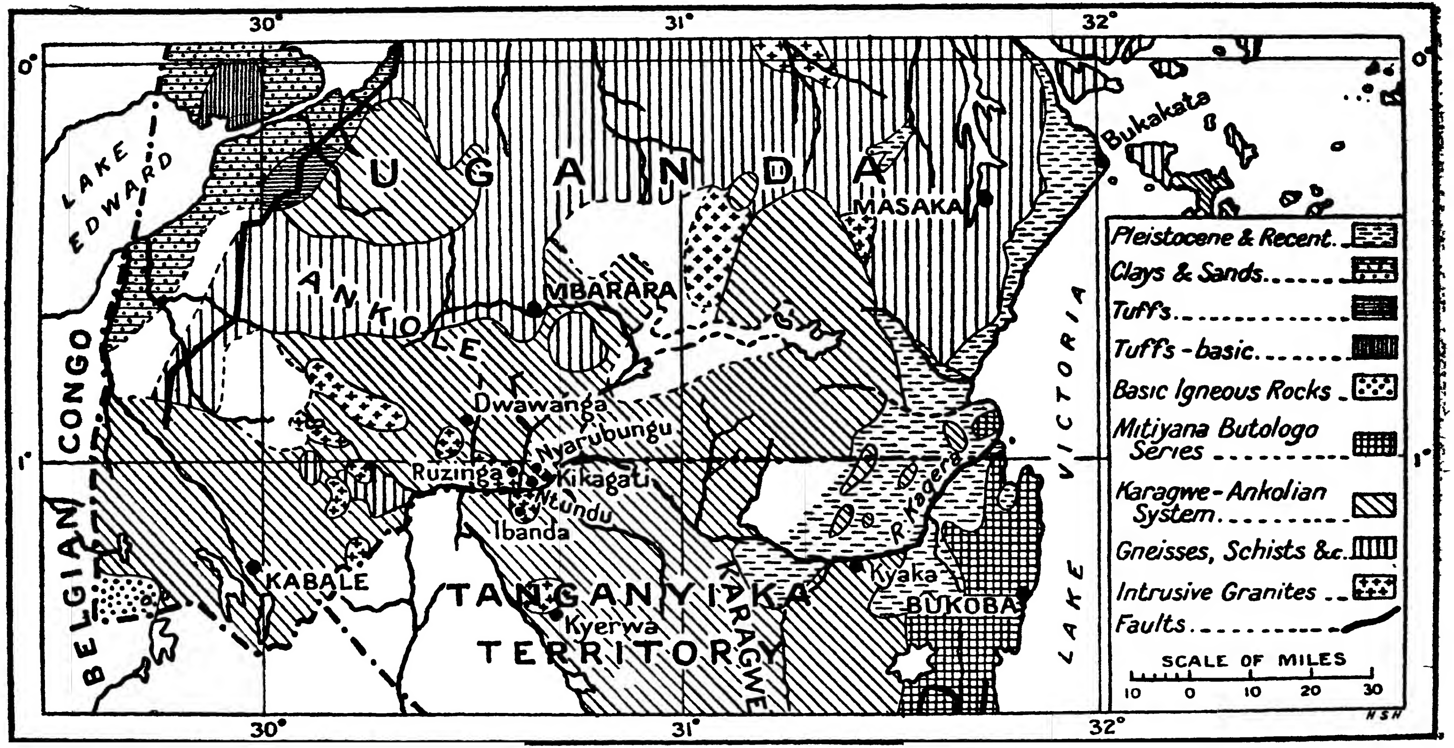
mountains formed by the rocks of the Karagwe-Ankolian System.

The quartzites exert a marked influence on the economic development of the country, owing to the rough strike ridges often being continuous for great distances and presenting wall-like faces which have to be surmounted or avoided in road construction. The eastern face of the Karagwe Highlands for practically the whole length of Karagwe is a great quartzite wall only breached in very few places.

The beds generally dip at high angles and are much folded. The denuded anticlines form more or less circular or elliptical areas of undulating to hilly country, surrounded by almost continuous wall-like ridges. Such areas have been termed " arenas " and are striking features of the topography in north-western Karagwe and south-western Ankole. The floors of these " arenas " are generally occupied by gneissic and granitic rocks, but over wide areas they are entirely devoid of outcrops of solid rock, nor are there any indications as to the nature of the underlying rocks. The contact of the granite with the Karagwe-Ankolian rocks is in many cases along the foot of the wall-like slopes surrounding the arena ; and in some cases the granites crop out high up on these walls.

The cassiterite deposits so far known occur along the arena walls and in the mountainous country up to two miles back from the arena walls, thus corresponding in a general way with the edges of the granite intrusions.

Near the granite intrusions, the Karagwe-Ankolian rocks have been tourmalinised to an extraordinary degree and contain a remarkable number of occurrences of quartz, as large reefs and dykes, small irregular veins and masses of all sizes, often containing much pyrite, and in some cases cassiterite. It will thus be seen that areas of the Karagwe-Ankolian rocks in the vicinity of intrusive granites are favourable ones in which to prospect for the possible location of tin and other mineral deposits, and so these rocks are of economic importance as well as of scientific interest. In the Rukiga Mountains extensive deposits of iron ore (mainly hæmatite) occur in the Karagwe-Ankolian rocks.



Ankole-Karagwe Map

THE CASSITERITE DEPOSITS

I. NORTH-WESTERN KARAGWE

1. *The Kyerwa Deposit.*—Kyerwa is about 75 miles west of Bukoba, on Lake Victoria, and 16 miles south-east of Kicherere Trig. Stn. (30° 10′ 08″ E. Long. 1° 10′ 50″ S. Lat.). The deposits occur in a narrow gorge which has its source in the Sena arena, and lies about two miles from the contact of the Karagwe-Ankolian rocks with the Sena granites, which rise into mountains reaching altitudes of 5,500 feet.

The Sena arena is roughly semicircular in shape and is bounded to the east, north and west by a practically unbroken wall of Karagwe-Ankolian rocks and to the south by the enormous swamp and lake areas of the Kagera Valley. The floor of the arena is occupied by a coarse-grained porphyritic muscovite-biotite granite from which the cassiterite of Kyerwa and neighbourhood has been derived.

The Kyerwa deposit consists of coarse and rough wash and shingle, filling the bottom of a deep and narrow V-shaped gorge, the bottom of which is often no more than a few yards in width, the cassiterite occurring in the wash as rounded or angular grains and lumps varying from fine sizes up to occasional masses weighing several pounds. The cassiterite is generally dark grey to black in colour, but much of it is of a light grey or buff colour. Rutile and black tourmaline are also found in quantities in the wash. Data regarding average value of the wash are not available, but tests made haphazard showed the tin-content to be high.

Rich patches consisting almost entirely of rounded lumps of cassiterite are occasionally found under large stones at the base of the gravels. At the time when this deposit was visited (March, 1925) the rich wash appeared to occur for a length of 500 yards along the bottom of the gorge, over a width of from 3 to 5 yards and at a depth of several feet. Since then, however, greater widths and depths of wash have been reported. The gorge has a very steep gradient and the lower limit of the deposit is determined by a bed of hard quartzite that crosses the gorge.

The cassiterite appears to have come from Kabulasoke Hill, on the western slopes of which is the head of the gorge. This is surrounded by steep amphitheatre-like slopes of mica-schist, over practically the whole of which coarse angular cassiterite occurs. A considerable quantity of cassiterite could be recovered from the hill wash and detritus on these slopes. Cassiterite was found also on the flat top of Kabulasoke Hill as well as on the south-western slopes. Cassiterite has been reported to have been found in situ in the mica-schist and in thin quartz veins lying along the foliation planes of the schist. Although, with the exception of these occasional grains, cassiterite has not been located in situ, it appears from the general evidence above outlined to have been derived from the weathering of very numerous quartz stringers and veins contained in the mica-schists, and from small pegmatitic veins which in some cases must have consisted almost wholly of cassiterite.

Since March, 1925, subangular and angular lumps of cassiterite have been found at Kifui, about 4½ miles north-west of Kyerwa, and at an intermediate locality coarse grains of cassiterite have been found in a pegmatitic rock. This pegmatitic material is very characteristic and has been found in constant association with the cassiterite deposits of Ibanda and southern Ankole. It is understood that cassiterite has also been found to the east of Kabulasoke Hill, near Nyaluzumbura. As there is a long line of contact adjacent to Kyerwa, between the Sena granite and the Karagwe-Ankolian rocks, conditions are favourable for the existence of other deposits.

Immediately above the village of Kyerwa, the deep gorge already referred to passes into a wide swampy flat leading to the Kishanda River, and it is possible that alluvial deposits may occur under the flat and in the river itself. The same applies to the extensive alluvial flats adjacent to the great Kagera swamps forming the southern boundary of Sena. A considerable amount of prospecting has been in progress recently in these areas.

2. *The Ibanda Deposits.*—Ibanda is the general name for an area of open undulating to hilly country, varying from 4,200 feet to 4,500 feet above sea-level, bordering

the Kagera River, in the extreme north-west of Karagwe, and also of a village, situated approximately 4 miles north-north-west of Kicherere Trig. Stn. Ibanda is situated in the south-eastern portion of the Chitwe-Ibanda arena, which lies partly in Uganda and partly in Tanganyika Territory.

The Ibanda deposits occur on the steep wall-like ridges of Rwanakigondo Hill, on the Ibanda-Nyakasa road, and consist of narrow quartz reefs cutting across the bedding of phyllites of the Karagwe-Ankolian System. They are about $\frac{3}{4}$ mile from the edge of the Ibanda granites, which resemble the Sena granites and outcrop over a large area, being part of a large intrusion that extends into Ankole.

The cassiterite occurs as irregularly distributed coarse blebs of a light brown colour, and is associated with pyrite and arsenopyrite, with smaller amounts of sphalerite and galena. The cassiterite, however, is not usually intergrown with the sulphides. Included in the quartz reefs are coarse-grained aggregates of a pegmatitic material consisting almost wholly of large flakes of mica. Much very coarse cassiterite is associated with these pegmatitic aggregates. This pegmatitic rock is the characteristic material mentioned in connection with the Kyerwa deposits.

At the time when these deposits were visited little work had been done on the quartz reefs, but they were not regarded as likely to yield a large quantity of tin ore.

Directly below the village extensive alluvial flats occur along the Chezu and Dubira water-courses, and offer favourable prospects for the discovery of alluvial tin deposits. Between the Ibanda deposits and the north end of the Irama ridge many quartz reefs occur, in some of which cassiterite has been found as well as in pegmatitic veins of the characteristic material already described.

II. Southern Ankole

1. *The Kikagati Area.*—Kikagati is the name of a very small village and adjoining flats on the Ankole side of the Kagera River, immediately downstream from the point where the Kagera River cuts through the Irama (Karagwe

side)-Nyarubungu (Ankole side) ridge, which forms the eastern wall of the Chitwe-Ibanda arena. The country bordering both sides of the Kagera River, near to and downstream from Kikagati, is rough and mountainous, rising to 5,600 feet above sea-level. The level of the Kagera at Kikagati is about 4,050 feet.

The deposits consist of quartz reefs, detrital deposits and alluvial deposits.

The Quartz Reefs.—The cassiterite-bearing quartz reefs occur along the south-eastern end of the Nyarubungu ridge, which is the direct continuation into Ankole from Karagwe of the Irama ridge. They occur in hard quartzite cutting across the dip, varying from mere stringers up to 5 feet in thickness. The quartz is usually of the opaque, white and grey varieties, while the cassiterite is mostly of a grey-brown colour, often with rough crystal faces, and occurs in the quartz as coarse grains and masses up to 5 inches in diameter. The distribution of cassiterite in the veins appears to be very irregular. Many of the quartz reefs seem to occur along joint planes.

Farther up the ridge on the north-western slopes, numerous lenticular reefs occur. Most of them are relatively short and irregular, but some are exposed continuously over several hundred feet. They vary in width from a few inches to a foot, but in many places up to six parallel veins occur, separated by from 1 to 5 feet of the enclosing hard blue quartzites. Cassiterite occurs in many of them exactly as in the cases described above. No exploratory work had been done on any of these veins at the time they were visited.

The Detrital and Eluvial Deposits.—Over the surface of the north-eastern slopes of the Nyarubungu ridge, particularly towards the south-eastern end, large angular and subangular lumps of pure cassiterite, up to five or six pounds in weight, were found scattered over the surface at various places, with smaller lumps and grains. This coarse cassiterite has clearly been derived from the weathering and denudation of many quartz reefs such as those seen in situ at the present time, and obviously they occur very close to the reefs from which they were originally derived.

At the time these deposits were visited, some 50 shallow pits had been sunk on the north-east slopes of Nyarubungu ridge, but were not sunk on any definite system. The detritus and hill wash contain much cassiterite, mostly as angular grains and sometimes as coarse lumps, clearly derived from the denudation of many tin-bearing quartz reefs such as occur along the higher slopes of the ridge immediately above the detrital deposits. These deposits occur over a length of at least 1,000 yards and are exposed in various pits for average depths of about 3 feet. It is stated that recent tests have indicated a content of about 5 lb. of cassiterite per cubic yard. Sufficient work has not been done to prove the quantity of material available for treatment, but it may be said that there is a very large supply of this cassiterite-bearing detritus and hill wash available on the north-east slopes of Nyarubungu ridge, which, from evidence contained in the test pits sunk, should yield a large quantity of tin.

The Alluvial Deposits.—Immediately downstream from where the Kagera River cuts through the Irama-Nyarubungu ridge, the valley widens out very rapidly on the Ankole side, and is bordered by an extensive flat to slightly undulating area, varying in width up to three-quarters of a mile and in length up to 2 miles. The area as a whole has the appearance of being formed of alluvial deposits and thus possibly of being underlain by gravel that may contain cassiterite. In a pit sunk in the flat about 800 yards below the Irama-Nyarubungu ridge, very coarse gravels occur to a depth of at least 12 feet, the pebbles consisting of quartz and quartzite derived from the immediate vicinity. At the time of the visit it was not possible to determine whether bedrock had been reached, but coarse grains of waterworn cassiterite were found in the spoil from the pit. Therefore, at least the gravels can be said to be tin-bearing and to warrant further investigation. How much of the plain is underlain by gravels can only be ascertained by systematic testing. However, in predicting the possible existence of extensive gravels under these flats great caution should be exercised, as, in a traverse made downstream, places were found in flats bordering the river where only thin and scattered gravels

underlie the flats. In several places bedrock occurs above the level of the present river bed, showing that the river has cut down through the older alluvial deposits.

There is an unlimited supply of water available for the working of the reef, eluvial and alluvial deposits of Kikagati.

Upstream from the Irama-Nyarubungu ridge, for about 7 miles along the Uganda side of the Kagera, very extensive flats occur up to 2 miles in width. As far as known, these flats have not yet been tested. The very large flat area between the southern foot of the Ntundu hill and the Kagera River, marked on maps as Shozo, and the flats round the lower portion of the Kabianda-Kivimbiri-Chezo watercourse, generally known to the local natives as the Kabianda, should be worthy of investigation, as cassiterite is known to occur on and around Ntundu Hill and along the Kabianda River in the neighbourhood of Ruzinga, Chamtwara and Naniankoko hills.

2. *The Ntundu Area.*—Ntundu Hill is a large rounded isolated hill rising to a height of about 400 feet above the general level of the Kagera and Chezo flats surrounding it, the summit reaching a height of 4,575 feet above sea-level. It is formed of mica-schists of the Karagwe-Ankolian System and stands on the arena floor well out from the main arena wall. The deposits have not been examined by the Survey, but specimens forwarded by the holder of the Exclusive Prospecting Licence covering the area consist of a coarsely crystalline light grey to white quartz containing coarse blebs and aggregates of a grey-brown crystalline cassiterite up to an inch in diameter, and thin irregular veinlets consisting of aggregates of needle-like crystals of black tourmaline. The cassiterite and the tourmaline are sometimes intimately intergrown, this being the only case known up to date in Ankole and Karagwe where the tourmaline and cassiterite are intergrown, or are even found in the same vein or reef. No information is available in regard to the extent of these deposits or of the eluvial material containing tinstone that is reported to occur on the slopes of Ntundu.

3. *The Ruzinga Area.*—Ruzinga is one of several isolated hills, on the eastern side of the Kabianda Valley, that stand on the arena floor a short distance from the

arena wall. Ruzinga is formed of light blue-grey phyllites and light grey-brown mica-schists of the Karagwe-Ankolian System.

The granites do not actually crop out round Ruzinga Hill, but do so a short distance to the west of the Ruhimbu River. The large area of gently undulating country between the hill and the river is doubtless underlain by granites.

On the top and slopes of Ruzinga Hill, cassiterite has been found in irregular masses of quartz and quartz veins of small extent. From the exposures seen it appeared that only a small tonnage of tin ore existed in these deposits. The cassiterite is a dark brown variety and occurs in a matrix of grey to white quartz. Irregular veinlets and scattered aggregates of mica occur in the quartz, the aggregates being up to 18 inches in diameter and containing very coarse lumps of cassiterite which is not invariably associated with the mica.

Eluvial deposits also exist on Ruzinga Hill, and numerous small shallow pits on the slopes have shown from 2 to 3 feet, and in one case 6 feet, of detritus and hill wash. These consist of angular fragments of the phyllites of which the hill is formed, together with quartz and small angular to subangular lumps of cassiterite. There appears to be a large quantity of eluvium on these slopes, but without systematic sampling it is impossible to frame an estimate. As there is no permanent or semi-permanent water supply in the neighbourhood of Ruzinga, these deposits would need to be sufficiently rich in cassiterite to warrant the expense of providing a water supply.

4. *The Naniankoko Area.*—Naniankoko is a more or less isolated hill on the eastern side of the Kabianda Valley some three miles north of Ruzinga and is formed of Karagwe-Ankolian rocks. This is the most northerly occurrence of cassiterite known at present near the Kabianda Valley. These deposits have not been seen by an officer of the Survey and the only information available is from specimens submitted. These consist of lumps of a coarsely crystalline dark-grey to black cassiterite up to 30 lb. in weight, with adhering coarse flakes of muscovite, suggesting derivation from either a pegmatitic vein or from a micaceous aggregate in a quartz vein.

5. *The Dwawanga Area.*—Dwawanga Hill (5,118 feet) is situated on the eastern side of the Kabagondo Valley in the southern Rwampara Mountains, and at a considerable distance away from any of the previously known localities in which cassiterite has been found, so that it may be said to be in an entirely new locality as regards the cassiterite deposits of southern Ankole.

Specimens brought to the Geological Survey from these deposits, stated to be "strong quartz reefs," consist of large lumps of a grey to white crystalline quartz with a saccharoidal texture, containing numerous coarse blebs of cassiterite. The hill wash on Dwawanga apparently also contains cassiterite.

The Kabagondo River to the east of Dwawanga Hill flows during the whole of the year and often has a large volume of water during the rainy season.

Dwawanga and the neighbouring mountains are formed of Karagwe-Ankolian rocks, Dwawanga itself apparently consisting of phyllites. The contact of the rocks of the Karagwe-Ankolian System with the northern edge of the Chitwe-Namiagga granites is situated at a distance of approximately 2½ miles south-west of the centre of Dwawanga Hill, at the foot of the northern wall of the Chitwe-Ibanda arena.

The granites of the Chitwe-Namiagga intrusion are of the coarse-grained porphyritic muscovite-biotite types, but contain much less muscovite than the Sena and Ibanda types. They form a roughly circular intrusion, about 6 miles in diameter.

Around Chabakonzo Hill, on the west of the Kasanda Valley and immediately south-west of the Chitwe-Namiagga intrusion, a small mass of a fine-grained biotite granite intrudes the rocks of the Karagwe-Ankolian System. A tourmalinised aplite containing arsenopyrite occurs in the intrusion, showing that this is a mineralised area. The surrounding area, therefore, would appear to be worthy of investigation with a view to the discovery of cassiterite.

GENERAL SUMMARY

The tin deposits of North-western Karagwe and southern Ankole occur over a wide area, the distance from

Kyerwa to Dwawanga being about 40 miles. One is justified, therefore, in expecting further deposits to be found in the areas adjacent to the granite intrusions above described. Except for the alluvial deposits of Kyerwa, development is still in the preliminary prospecting stage. Up to the middle of 1926, about 40 tons of tin concentrate had been produced at Kyerwa, 30 tons having been shipped from Bukoba. Up to the present there has been no production in southern Ankole. In the country west and south-west of the known cassiterite areas of southern Ankole, there are many large granite masses intruding the rocks of the Karagwe-Ankolian System, the geological and topographical conditions being exactly similar to those of the known tin-bearing areas. A detailed geological map of this country has been prepared. Near Kamwezi, immediately to the south-west of the country so mapped, another large intrusion of granite occurs in rocks of the Karagwe-Ankolian System. This granite runs south-westerly from Kamwezi along the foot of the south-eastern edge of the Rukiga Mountains. This line of contact and its vicinity offer favourable possibilities of further discoveries of cassiterite. Immediately west of Ntungamo, at mile 42 on the Mbarara-Kabale road, is another large intrusion of coarse-grained porphyritic muscovite-biotite granite intruding rocks of the Karagwe-Ankolian System and extending for a long distance in a west-north-west direction. Farther west along the northern edge of the Rukiga and Chinchizi mountains, in the Kigezi Administrative District, there is another long line of contact between the Karagwe-Ankolian rocks and a large granite intrusion. These last-mentioned areas have not been properly prospected, and it is evident, therefore, that large areas yet remain to be prospected that are geologically favourable for the occurrence of deposits of cassiterite.

TRANSPORT FACILITIES AND SUPPLIES

Transport Facilities

1. *North-western Karagwe.*—The Kyerwa area is reached at present by a circuitous route crossing the

Karagwe Highlands from Bukoba via Kyaka, Kitengule, Kisojo, Bugene and Kyamutaga, a distance of about 112 miles. The road is being used by light lorries, but would require re-grading and metalling for heavy traffic. Ibanda could be reached without crossing the Highlands by following the Kagera Valley from Kitengule to the Irama-Nyarubungu ridge and thence by a suitable route through the granite hills. This route would be long and circuitous. The Kagera River is not likely to be of service for the Kyerwa area, but might be utilised for Ibanda as discussed below in connection with the southern Ankole areas.

2. *Southern Ankole.*—The cassiterite deposits are reached at present from Bukakata, a port on Lake Victoria, along the main motor road to Mbarara, a distance of about 115 miles, thence to Ntungamo, 42 miles on the road to Kabale, and finally by a circuitous motor road for 30 miles to Dubollogot. The cassiterite areas are reached by foot-tracks from Dubollogot, but roads of easy grade could be made without difficulty.

With regard to the use of the Kagera River as a means of transport, it is stated to be navigable as far as Nsongezi, about 6 miles downstream from the Kikagati deposits, but between Nsongezi and Kyensambi, a distance of about 17 miles, there are small rapids and rocks in the river. If these obstacles prevent navigation between these points, 23 miles of road would be required from Kikagati to Kyensambi along the Kagera Valley, a matter of no engineering difficulty.

Timber, Fuel and Water Supplies

In the areas where tin has already been discovered, a limited quantity of timber is available from the forested gullies, and considerable quantities of thorny acacia, suitable for fuel, exist on the areas as thick scrub. Over a large area to the west of the present discoveries the country is devoid of timber.

As regards water supplies, an unlimited quantity is available at all times from the Kagera River, while the Kabagondo-Chamwasa-Bizi River is permanent though smaller. Practically all the valleys in the region con-

sidered are dry for the greater portion of the year, and for deposits away from the aforementioned rivers schemes of water conservation will be necessary. The country to the west, however, is much better off as regards water supplies.

NOTES

Imperial Institute Exhibit at the British Industries Fair.—At the invitation of the Department of Overseas Trade the Imperial Institute again arranged an exhibit at the British Industries Fair which was held in London from February 21 to March 4, 1927. Space was allotted in the Empire Marketing Board section and consisted of five bays, each 17 ft. by 17 ft.

The first bay was devoted to a representation of the work of the Exhibition Galleries. In this were arranged two typical exhibits in show-cases, one illustrating the coconut palm products of East Africa, and the other the West African oil palm industry. An illuminated diorama of a scene in Nigeria showed the collecting of palm fruits and the preparation of palm oil. The utilisation of palm oils in this country was illustrated by a series of samples kindly presented by Messrs. Lever Bros., Ltd. A selection of free literature distributed from the Central Stand of the Institute was also on view.

The second bay contained an exhibit of selected Empire raw materials and products derived from them which have been recently investigated by the Plant and Animal Products Department; they included silk, paper-making materials, oils and oil-seeds, essential oils, resins, tanning materials and drugs.

Some of the specimens represented materials which had been obtained experimentally with a view to determining the feasibility of their production in commercial quantities. As examples of these were cascara bark from Kenya Colony; camphor prepared at the Institute from material received from Uganda and St. Lucia; and essential oils from various countries.

Another class of exhibits illustrated investigations carried out with the object of promoting the commercial development of existing natural resources. Among these were shea nuts and butter from West Africa; Illipe nuts and fat from North Borneo; damar penak (a varnish resin) from the Federated Malay States; and sumach (a tanning material) from Cyprus.

Reference may also be made to peeled ginger and

ginger peelings from Sierra Leone, where an endeavour is now being made to prepare peeled ginger for export instead of the roughly scraped material hitherto produced. The peelings obtained as a by-product have been examined at the Institute and found to yield good percentages of oil and extract of excellent quality.

The silk exhibit included a bale of reeled silk from Cyprus where, as a result of the activities of the Institute's Advisory Committee on Silk Production, a filature has recently been established (see this BULLETIN, 1926, **24**, 451). Fabrics woven from this silk were shown, together with a series of samples illustrating the utilisation of waste silk from Cyprus. Silk reeled from cocoons from Jamaica, Rhodesia and Iraq, and fabrics made therefrom were also exhibited.

Two bays were devoted to rubber, the exhibit being arranged in collaboration with the Rubber Growers' Association. This exhibit comprised two illuminated dioramas, one of which showed a rubber plantation in British Malaya, and the other illustrated the tapping of rubber trees. The Rubber Growers' Association supplied specimens of latex and raw rubber, together with a collection of manufactured articles illustrating recent applications of rubber.

The fifth bay contained the exhibits of the Mineral Resources Department, which were for the most part suggested by enquiries and work done at the Institute during the preceding year. In a central show-case there were samples illustrating recent discoveries of minerals of economic importance in British Africa ; these included hæmatitic iron-ore from Sierra Leone, tin ore from Tanganyika, platinum ores from the Transvaal, and manganese ore from Cape Province.

In the surrounding cabinets were displayed commercial samples of metallic ores of Empire origin, together with metals and manufactured products derived therefrom, including aluminium, nickel, chromium, cobalt, beryllium, tantalum and molybdenum. Cases were also set apart for certain mineral and manufactured products of the non-metal group, including graphite, asbestos, mica and titanium oxide paint. Added interest was given to these exhibits by the display, on the walls above the show-cases, of photographic enlargements and other illustrations of mining and metallurgical activities in connection with the exploitation of the minerals exhibited. The exhibits also included Imperial Institute publications on minerals, mineral statistics and mining laws, copies of which were on sale.

These exhibits attracted considerable attention from visitors and led to numerous enquiries being received regarding the products represented and the work of the Institute. Officers of the Imperial Institute were in attendance during the period of the Exhibition to give verbal information and to receive requests for further particulars which were supplied by the Intelligence Sections.

Rubber Production in Africa.—A further part of the crude rubber survey of the world that is being issued by the United States Department of Commerce has appeared recently as *Trade Promotion Series, No.* 34, *of the Bureau of Foreign and Domestic Commerce.* Previous parts, dealing with the Philippines and Amazon Valley, were noticed in this BULLETIN (1926, **24**, 251). In the present part, after a brief general reference to the wild and plantation rubbers of tropical Africa, the conditions obtaining in the various countries under British, French, Belgian, Portuguese and Spanish rule, and in the Mandated Territories of Tanganyika, Cameroons and Togoland, and in the Liberian Republic are dealt with in detail. In most cases particulars are given of the topography, climate, land tenure, and labour of each country, and an account of the present position and possibilities as regards the production of wild and plantation rubber.

In a prefatory statement by the Director of the Bureau of Foreign and Domestic Commerce it is pointed out that there is at present the equivalent of at least 38,000 acres of planted Hevea in the equatorial belt of Africa, a large proportion of which has been interplanted with other crops, such as coffee and cocoa. Practically all of this planted rubber is mature, and would be capable, if fully tapped, of yielding upwards of 5,000 tons annually of Hevea rubber alone. A much larger acreage has been planted with other kinds of rubber, Manihot, Castilloa, Funtumia, and other less important species. Since much of the plantings of these has now been abandoned or destroyed, it is impossible to estimate the acreage i existence or the amount of rubber that could be obtained from them were they fully tapped. The peak years of production in Africa during the present century were 1906 and 1910, when 20,000 tons were exported. This was practically all wild rubber, mainly from *Funtumia elastica* (Lagos silk rubber) and species of *Landolphia* (vine rubber). Many of the forests have, however, been depleted of their rubber-producing plants, and for this and other reasons it is considered that the output of wild rubber may not again reach such a high figure. The opinion is expressed,

however, that should high prices continue over a number of years, the present planted areas may be expected to contribute a much larger share to the world's supply of cultivated rubber than in the recent past; and furthermore, high prices may stimulate new plantings. Already, it is pointed out, one American concern has commenced planting operations in Liberia, and expects eventually to have a large acreage under Hevea.

Tobacco Industry of Canada.—According to a *Press Bulletin* issued from the office of the High Commissioner for Canada in London, the estimated production of tobacco in the Dominion in 1926 amounted to 28,824,000 lb. The corresponding figure for the previous year (as published in the *Report of the Officer in Charge of the Tobacco Division, Dominions Experimental Farms, for the Year* 1925) was 29,266,000 lb. The area under the crop rose from 27,825 acres in 1925 to 33,356 acres in 1926, the decrease in the yield being attributed to unfavourable weather conditions (frost and flooding) during harvesting and curing in Ontario, where 70 per cent. of the crop is produced. The total average aggregate losses in Ontario due to this cause are computed to be as follows: Burley 31 per cent., flue-cured 20 per cent., Green River 26 per cent., and snuff tobacco 7 per cent. The weather conditions in the south-west of the province during the autumn of 1926 are stated to have been very unusual, and among the worst ever experienced. In Quebec and British Columbia, on the other hand, the conditions were favourable, and a good crop was expected.

In Ontario the chief centres of production are the Essex and Kent counties bordering Lake Erie in the extreme south-west of the province, with smaller areas in Elgin and other neighbouring counties. The area and estimated yields of the various kinds of tobacco in Ontario in 1926 were as follows:

	Burley.	Flue-cured.	Green River.	Snuff.	Total.
Area . . . *acres*	12,217	6,429	4,438	409	23,493
Estimated yield per acre . *lb.*	1,314	842	1,267	1,300	1,176
Estimated prospective production . . . *lb.*	16,053,000	5,413,000	5,623,000	532,000	27,621,000
Average estimated loss due to unfavourable weather conditions in September and October . . . *lb.*	4,976,000	1,082,000	1,462,000	37,000	7,557,000
Estimated total of saleable tobacco . . . *lb.*	11,077,000	4,331,000	4,161,000	495,000	20,064,000

The principal tobacco-growing region of Quebec is L'Assomption county with the adjoining part of Montcalm county. There is also a considerable production of

tobacco in Joliette and Rouville counties, with smaller areas in several other counties. All these areas are in the neighbourhood of the St. Lawrence river in the south of the province. The total area and estimated yield of tobacco in Quebec in 1926 is stated to be as follows:

		Cigar tobacco.	Large pipe tobacco.	Small pipe tobacco.	Total.
Area	*acres*	4,923	3,160	1,725	9,808
Estimated average yield per acre	*lb*	960	955	550	886
Estimated production	*lb*	4,726,000	3,018,000	949,000	8,693,000

In British Columbia tobacco is confined to the Okanagan Valley, situated in the extreme south about 170 miles from the coast. Here there were 55 acres under the crop in 1926, the estimated production being 67,000 lb.

Empire Forestry Journal.—The current number of this Journal (Vol. v, 1926, No. 2) contains a most useful and varied selection of articles and notes on forestry subjects, and in large measure furnishes a review of forestry activities during the year. Reference is made to the succession of forestry conferences held in different parts of the world during 1926 and accounts are given of the proceedings of three of these meetings, namely the World's Forestry Congress in Rome, the Forestry Section of the International Congress of Plant Sciences at Ithaca, New York, and the Imperial Conference Sub-Committee on Forestry in London. J. B. Clements, Conservator of Forests, Nyasaland, deals with the destruction of the forests in the Protectorate and the need for "protection" forests to conserve the soil moisture and water supplies. A new Forest Ordinance promises to arrest some of the evils which threaten the country in this direction. The re-afforestation work carried out in Mauritius is described by P. Koenig, Director of Forests, in an interesting illustrated article, and the important question of the supply of railway sleepers in India is discussed by J. H. Warr (Dehra Dun). Under the title of *Notes on Tropical African Timber Trees*, Dr. J. Burtt Davy gives a list of new identifications of Gold Coast timber trees which is referred to elsewhere in this BULLETIN (page 73). Forestry in East Africa is discussed in extracts from the report of the East African Commission which visited Africa under the Chairmanship of Mr. Ormsby Gore, M.P., and extracts from Mr. Ormsby Gore's report on his tour in British West Africa in 1925 deal with the forests of that important part of the Empire. The Journal also contains the usual series of useful reviews of books and publications and interesting editorial notes.

ABSTRACTS OF RECENTLY PUBLISHED LITERATURE ON AGRICULTURE AND FORESTRY

In this section a summary is given of the contents of the more important, recently published papers and reports relating to tropical agriculture and forestry. It must be understood that the Imperial Institute accepts no responsibility for the opinions expressed in the papers and reports summarised.

Foodstuffs and Fodders

Cocoa.—*Bull. No.* 3 (1926), *Dept. Agric. Gold Coast,* entitled "Preliminary Study of the Life History and Habits of Sahlbergella Singularis, Hagl. and S. Theobroma, Dist.," deals with the life-histories and habits of the two most destructive pests of cocoa in the colony, and suggests possible methods of control. Damage is caused by the adults and nymphs sucking stems and shoots up to two or three years old, resulting as a rule in the subsequent death of the part affected. The bugs have been found to have some toxic effect on the plant which continues long after the original injury has occurred and is supposed to be due to the introduction of a toxic substance with the salivary juices at the time of puncturing. Both species are found congregating under maturing pods of bearing trees, a month or two previous to the harvesting of the crop. Natural controls are not common. An internal nymphal parasite and a spider which is predaceous on the nymphs are apparently the only specialised checks. Cultural control measures consist of keeping the trees in a healthy condition, while the only artificial means that are likely to be of use are spraying or dusting with nicotine sulphate.

Sugar.—The results of an enquiry into the production of cane sugar in Natal are given in a *Report on the Sugar Industry, Board of Trade and Industries, Report No.* 66, 1926, *Union of South Africa.* The Board considers that the sugar industry is not being conducted on sound economic lines, and makes a number of recommendations designed to stabilise the industry. It is pointed out that a spirit of co-operation between the various interests is essential in order to secure united action to improve the organisation of the industry. The Board's recommendations include: the revision of the 1905 Miller-Planter Agreements and the Pass Laws, the establishment of a bureau of pathology and entomology to co-operate with experimental field work, chemical research to be carried out for the industry as a whole, and numerous improve-

ments on the commercial side of the industry. The South African Sugar Association alleged the dumping of sugar against Mozambique, and the Board considers that the carriage of sugar from that country on Union railways at South African produce rates is an anomaly that needs correction. The Board has decided not to support any proposal involving public funds for establishing a beet-sugar industry in the Union for the following reason. The enquiry shows that the established cane industry has reached a stage of virtual over-production, and during 1926 was compelled to export roughly 70,000 tons of sugar at a loss. If the industry is re-organised the loss can be obviated or greatly minimised. Fresh lands in the cane belt are available, and if the planters were supervised and assisted in a sugar-cane scheme, the cost to Government would be less than in building up a beet-sugar industry practically from its foundations.

In a paper in *Bull. Entom. Res.* (xvii, Part 2, October 1926) on the causes of froghopper blight of sugar-cane in Trinidad, E. Philpott Mumford states that there appear to be two main causes of blight, namely, attacks of the froghoppers (*Tomaspis saccharina*), and attacks of root fungi (*Marasmus and Odontia*).

The susceptibility of the cane to attacks of root fungi has been shown to be largely due to debility of the plant resulting from unfavourable soil conditions, and the injury appears to be most severe in times of drought.

It is suggested that susceptibility to froghopper attack is due to causes which disturb the water-balance of the cane, a disturbance which would be even more marked if the roots were diseased.

Conditions which appear to be particularly harmful are prolonged periods of drought or of excessive rainfall, and also drought following spells of excessive wet weather. The questions arise as to whether the number of attacking organisms can be decreased, or whether it is more feasible to increase the cane's resistance to attack.

In the past, it has been customary to consider almost entirely the first question, but it is realised at the present time that an answer to the second question is quite as urgently demanded.

Unhealthy canes are undoubtedly more susceptible to attack than healthy ones, using the term " health " to denote vigour and capacity to resist adverse environmental conditions, and not as merely denoting luxuriant growth.

Beet Sugar.—An account of the improvements which have resulted from recent researches at Oxford into the

desiccation method of producing sugar from sugar beet is given in *Journ. Min. Agric.* (1927, **33**, 986). It has been found that the methods of previous investigations were conducted upon wrong hypotheses, namely, the drying of the beet to exhaust most of the moisture for the complete coagulation of the albuminoids, and the rupture of the cellular walls. It is now established that there is no rupture of the walls, and that prolonged heat coagulation is not essential. Furthermore, no such action as lixiviation takes place, the cellular walls are not ruptured and consequently there is only simple diffusion.

The drying of the cossettes has been accomplished in a single operation in place of two stages as advocated in the De Vecchis process. An extracting apparatus has been designed whereby the cossettes are exhausted and yield a syrup in one continuous operation, the method being more effective and expeditious than the previous attempts. A process has been devised for defecating the syrups, which produces a final liquor more highly purified and more readily crystallisable than that obtained by former processes.

Ensilage of Sugar Beet Tops.—A paper on this subject by H. E. Woodman and A. Amos appears in *Journ. Agric. Sci.* (1926, xvi, Part 3, p. 406). Tables are given showing the composition of sugar beet tops both before and after ensiling, and that of sugar beet tops in comparison with wheat chaff and with a silage made from a mixture of beet tops and wheat chaff. The conclusion is reached that in normal times it is doubtful whether the ensiling of sugar beet tops would be a paying process for the following reasons:—the difficulty and expense of carting the tops, and transferring them into a tower silo, and the fact that at the season of cutting the tops the silo is frequently full, and the contents are ready for being fed to stock.

It is doubtful whether ensiling in a clamp, or pit, would be satisfactory, as the wetness of the green tops would entail a copious draining away of juice accompanied by excessive losses of nutrient matter and the silage would almost inevitably be sour.

It is suggested that the most economical method of utilising the tops is to allow sheep or cows to eat them directly off the land, or in the case of large areas, where it may not be possible for the whole of the tops to be consumed before decomposition commences, to plough them in as manure.

It is pointed out that the preservation of sugar beet tops must be looked upon chiefly as an emergency measure

to be adopted in times of food scarcity (e.g. war-time). It has been shown that if whole tops be ensiled and care be taken to ensure tight packing, silage of good quality results.

Sunflower Seed Cake.—Partially decorticated Russian sunflower seed cake, containing 40 per cent. of protein, has been the subject of feeding tests with pigs at the Rowett Research Institute. The results indicate that this cake has about the same feeding value for pigs as extracted soya bean meal, and decorticated ground-nut cake. If the sunflower seed cake can be imported at a rate substantially less than these materials, it would appear to be advantageous to the pig feeder to use it. It is intended to continue these feeding experiments on other classes of farm stock (*Scottish Journ. Agric.*, 1927, **10,** 71).

Cold Storage of Fruit.—An important desideratum in the cold storage of fruit is the attainment, so far as possible, of uniformity of temperature. The permissible limits of temperature are comparatively narrow. The upper limit depends upon the rate at which the fruit matures and the time for which it is to be kept ; the lower limit is fixed by the temperature at which each particular variety of fruit becomes liable to internal breakdown. The longer the period of storage the closer do these limits approach.

Even within the permissible range, variation in temperature is not desirable, one reason being the tendency, in an atmosphere almost saturated with water vapour, for a very slight fall in temperature to produce a deposition of moisture, a condition encouraging the development of moulds and rots.

There are practical difficulties in the way of securing uniform refrigeration throughout a cold storage chamber. The problem is further complicated by the fact that the fruit itself is constantly generating heat ; and an additional factor common in the case of small storage chambers is the intermittent working of the refrigeration plant.

All the above considerations are dealt with in *Food Investigation Special Report No.* 29, 1926, issued by the Department of Scientific and Industrial Research, and entitled " Temperature Conditions in Small Cold Storage Chambers Containing Fruit."

The report gives a detailed account of the investigation of temperature distribution in five cold storage chambers of different dimensions, containing apples, and having various refrigeration systems.

It was found that in any particular chamber there is a more or less stable distribution of temperature throughout the fruit stack, which tends to be restored after any temporary disturbance. Where the refrigeration is not continuous there are also regular variations in temperature when it is started and stopped. Forced air circulation does little to bring about uniformity of temperature, and in some circumstances it may even accentuate inequalities. A practical conclusion from the investigation is that if refrigeration cannot be uniform and continuous it is best applied to the top of the fruit stack, whence it is distributed throughout the whole by convection, vertical spaces being left between the cases of fruit to facilitate air circulation.

Fluctuations in temperature due to intermittency of operation appear to be smaller than differences due to uneven distribution of refrigeration, and where the brine system is used they can be further reduced by making the pipe surface small in relation to the volume of brine, thereby decreasing the rate of transfer of heat between the air and the pipes.

Essential Oils

Spike Lavender.—An article on the cultivation of spike lavender in Gard, Herault, Aude and Pyrénées-Orientales, the departments of France forming the Mediterranean Seaboard of the Plain of Languedoc, has been published in *La Parfumerie Moderne* (1926, **19,** 203). The plants are found growing abundantly with thyme and rosemary on rough stony uncultivated ground situated above the vine lands, at elevations up to about 500 metres. Although hardier than the true lavender, *L. vera,* D.C., spike lavender does not thrive in very exposed positions. Harvesting, which is carried out largely by women, commences at the beginning of August, even if the plants are not in flower, for in September the labour is required for the vintage. Distillation is generally conducted in stills of about 2,000 litres capacity, heated by open fire, although several steam stills are in operation. Where direct heat is employed the oil is stated to be more soluble as the difficultly soluble sesquiterpenes, which are of no value, are retained in the still. The yield of oil varies from about 0·77 to 1·25 per cent., with an average of about 0·90 per cent.

Oils and Oil-seeds

Coconuts.—The quantity of copra exported from the Federated Malay States in 1925 was 974,355 pikuls, valued at 11,260,299 dollars, compared with 893,712 pikuls, valued at 9,641,012 dollars, in 1924 (*Ann. Rep.*

Dept. Agric., F.M.S., 1925, p. 5). Observations on the yields of coconut palms have been continued and indicate that good palms remain proportionally good yielders from year to year, while poor ones continue to give poor yields. The cultivation of cover crops in the country is extending. Spraying with lead arsenate has proved effective against larvæ of the moth of *Setora nitens*.

Three papers published in the *Malayan Agricultural Journal* for October, 1926, deal with some aspects of the *Artona catoxantha* problem, and an account is given of the life-history of this zygænid. The most common parasites are *Ptychomyia remota* and Braconid No. 1085, which is possibly a species of *Apanteles*. One of the papers is devoted entirely to the former parasite. The efficiency of this tachinid is largely curtailed in Malaya by hyper-parasites, but nevertheless it is always capable of parasitising 30 to 40 per cent. of the larvæ of *Artona catoxantha* and in most cases more. It therefore may be considered a fairly efficient parasite in its own habitat, and offers good possibilities as an introduced parasite. Another of the papers takes the form of a preliminary note on "Chalcid No. 1594," one of the hyper-parasites of *P. remota*, the identity of which has not been definitely determined. It is very close to *Melittobia clavicornis*, though not of the same species.

The control of the "black-headed caterpillar" (*Nephantis serinopa*) by parasites is discussed in *Agric. Journ. India* (1926, **21**, 452). This caterpillar is a fairly common pest in South India, and lives on the lower surface of the leaves. Cutting and burning the infested fronds is not entirely successful in effecting a complete eradication of the pest, while spraying with insecticides is impracticable, owing to the height of the palms. On the East Coast this caterpillar has been controlled naturally and successfully by parasites. In the plains of South India the following parasites have been found: *Stomatoceras sulcatiscutellum*, a chalcid wasp attacking the pupa; a Bethylid of *Perisiersla* sp., a fairly efficient parasite attacking full-grown caterpillars; a Braconid of *Apanteles* sp. (?), which usually occurs with the Bethylid, but attacks young caterpillars; and *Elasmus nephantidis*, occurring mostly on palmyra palms and rarely on coconut palms, and attacking caterpillars about to pupate. The first three named are liable to attack by hyper-parasites.

These parasites were introduced into Mangalore in 1924, and have given successful results. The numbers of

black-headed caterpillars have been reduced and palms which once were severely infested have begun to yield as usual. The outlook is considered to be distinctly hopeful. The success of this parasite control is ascribed to the fact that the parasites attack the pest at different stages of its growth. In Cochin another parasite has been noted, namely, the Eulophid, which attacks the pupæ. It is the most efficient parasite in Cochin. Attempts have been made to introduce this Eulophid into Mangalore, and also in the neighbourhood of Coimbatore.

Ground-nuts.—Satisfactory results have attended the efforts to improve the quality of Gambian ground-nuts. The percentage of foreign matter has been reduced from an average of 8·2 in 1923–24 to 1·7 in 1924–25 or well within the limit of the trade allowance of 2 per cent. (*Ann. Rep. Dept. Agric., Gambia,* 1925). The average weight of the nut has increased and the amount of free fatty acids in the oil prepared from the kernels has decreased from 4·75 per cent. in 1923 to 1·53 per cent. in 1925. As a result of these improvements the price of Gambian ground-nuts has risen to within 5*s.* per ton of that of Rufisque. This progress has resulted from seed selection; increased attention to weeding; the fixing of the date for the sale of ground-nuts (December 1st), thereby ensuring that the nuts have ample time to mature before being harvested; the use of raised platforms for storage before threshing; compulsory screening; and the reduction of the number of buying centres, thereby enabling more efficient control to be exercised.

The quantity of ground-nuts exported showed a decrease in comparison with the previous year; in 1925, 48,700 tons, valued at £693,097, were exported, against 60,622 tons, valued at £861,925, in 1924. The crop for 1926 was expected to be 58,000 to 60,000 tons. It is considered that the opening up of the country by roads is essential for increasing the production.

Tentative proposals are outlined for a Government ground-nut seed supply and depot scheme, the object of which is to guarantee that sufficient seed is reserved each year to raise 40,000 tons of ground-nuts. For the working of this scheme it is proposed that the Government should make a loan of £11,500 for four years, after which the accrued profits would be used as working capital.

Manurial experiments have been carried out at the Agricultural and Botanical Station, and so far tend to show that a fertiliser of dried blood and bone meal would be most suitable for general use.

Oil-palm.—In the *Address by His Excellency the Governor on the Occasion of the Opening of the 1926–27 Session of the Legislative Council, Sierra Leone,* it was stated that the Government's proposal to select and improve an extensive area (2,000 acres) of wild palms in each of the three provinces had had to be modified (see this BULLETIN, 1926, **24**, 478). According to this modified scheme, in order to demonstrate the effect of cultivating existing stands, at certain selected headquarters a small palm area of 5 acres is to be set apart as a communal plantation, and is to be improved by employing modern methods of cultivation. Kawei, a thick-shelled variety, is most commonly met with in Sierra Leone, but it contains less pericarp than Henoi, which has a thin-shelled nut. It is, however, not intended to eliminate Kawei from these stands unless the Henoi variety predominates, since the object of the scheme is to demonstrate the improvement that can be effected in each variety of palm. Each stand will be planted up with whichever variety predominates. Demonstration plots have been or are to be started at Makeni, Makump, Kennema, Gorahun and Puyehun. It has not been possible to make any beginning with the model plantation proposed by the Government (see this BULLETIN, 1926, **24**, 478) as a thorough medical and sanitary examination of the Mabang area is to be made before settling on that district as the site.

The palms of Nigerian origin, planted at Njala in 1920, have recently come into bearing. During the first nine months of 1926, 1,624 lb. of fruit were harvested, or 180 lb. per acre per month. This yield is expected to be doubled in the next few years.

Trials have been carried out with the "Culley," "Delta Junior," "Knox" and "Rapid" palm-nut cracking machines. The results have been promising, and the machines are regarded as mechanical successes. Their regular use cannot be expected to come about quickly, but the saving of time and the increase of output which the machines effect should commend them to the more enterprising among the native communities.

In 1925 a record total of 63,231 tons of palm kernels were exported from Sierra Leone, the bulk of them going to the United Kingdom. The export of palm oil for the same period was 2,988 tons. According to the "Water-borne Produce and Palm Kernel Standard Rules," enacted at the end of 1925, palm kernels intended for export must not contain more than 4 per cent. of extraneous matter. As a result Sierra Leone kernels are now sold on the same basis as "Fines," namely, 49 per cent. oil

content. There is now under consideration a proposal to have a more comprehensive supervision of this product, the cost to be met by an addition of *6d.* per ton to the export duty. Under the provisions of the Native Produce Ordinance, the export is prohibited of all palm oil containing more than 2 per cent. of water and other extraneous matter.

According to the *Annual Report of the Director of Agriculture, Federated Malay States, for* 1925 (p. 6), the area under the cultivation of oil-palms in 1925 in that country was 8,412 acres, of which 1,654 acres in Selangor had been planted during the year. The exports of palm-oil and kernels in 1925 were respectively 536 tons and 110 tons as compared with 286 tons and 81 tons for the previous year. Satisfactory results were obtained in investigations on the bleaching of palm oil to render it suitable for cooking purposes locally in lieu of ground-nut oil.

The artificial fertilisation of oil-palms is described in *L'Agron. Colon.* (1926, **15**, 129). As the male spadices flower before the female, it is necessary to keep the pollen for a short time after it has been collected. The collection of the pollen is best made in the early morning, the weather being then usually calm, insects less active, and the hygrometric state of the atmosphere high and the grains of pollen therefore more adherent. Details are given of a method of collection. The collected pollen is kept best in the presence of anhydrous calcium chloride. Under these conditions it will retain its activity for from four to six weeks. The objects of artificial fertilisation are stated to be two-fold. It may be practised in order to increase the productivity of a plantation on a commercial scale, as was done in Malaya, or for purposes of selection, the pollen being applied either to female flowers of the tree from which the pollen was collected (i.e. auto-fertilisation) or to those of another palm (i.e. hybridisation). The modus operandi for fertilising the female flowers is described. Emphasis is laid on the necessity for guarding against cross-fertilisation by pollen from a neighbouring palm. This is prevented by enclosing the treated flowers in paper cones for the first four days after the introduction of the pollen.

Okra Seed.—Six samples of okra seed (*Hibiscus esculentus*) examined at the Agricultural Experiment Station, Raleigh, N.C., U.S.A., had the following composition, calculated on the moisture-free material: proteins

27·28 per cent., fat 21·72 per cent., fibre 31·37 per cent., and ash 4·7 per cent. These analyses show that okra seed contains 6·5 per cent. more proteins than undecorticated cotton seed. It is considered that the plant, being prolific and a vigorous grower in the cotton belt, has possibilities of economic importance, due to its high oil content, and to the feeding value for animals of the meal remaining after the oil has been extracted (*Journ. Oil and Fat Indust.*, 1926, **3**, 386).

White Sweet Clover Seed.—An investigation has been undertaken to ascertain whether the constants of the oil prepared from white sweet clover seed (*Melilotus albus*) grown in the United States are similar to those of oil from seed purchased in Hamburg, and to determine the commercial value of the oil (*Journ. Oil and Fat Indust.*, 1926, **3**, 382). The seed used in this investigation was grown at Highmore, South Dakota, by the Department of Agronomy of South Dakota State College. The American seed was found to yield on extraction with ether 5·26 per cent. of a greenish-amber oil, possessing a characteristic coumarin-like odour. The constants of the oil were markedly different from those of the oil from the Hamburg seed, and this difference tends to indicate that the oils from the seed, grown under varying conditions of soil and climate, differ widely in their chemical composition. The oil from the American seed is considered to possess commercial value as a drying oil.

FIBRES

Cotton

Empire Cotton Experiment Stations.—The Empire Cotton Growing Corporation has recently published a collection of "Reports received from Experiment Stations, 1925–26" (London, 1927, price 2*s.* 6*d.* post free), which contains reports from a number of different stations and from the Corporation's Seed Farm in Nigeria. These reports form a record of patient and industrious work, much of which has been directed to the control of pests, especially by the breeding of resistant strains and by devising means of trapping the insects at an early stage. Experiments are in progress in all the countries with a view to the discovery of the varieties of cotton best suited to the prevailing conditions.

Queensland.—In a report by W. G. Wells on the work of the Callide Cotton Research Station, near Biloela on the Rannes Branch of the Dawson Valley Line, during

the year ending June 30, 1926, it is stated that the experiments demonstrated that cotton can be grown very successfully in the Callide Valley. The cotton under cultivation is the B type of Durango, and a supply of seed is being obtained by bulk selection for commercial planting. Careful selection of the individual plant under the progeny row system is also being carried out with a view to the production of a uniform strain which will eventually replace the bulk-selected cotton. The only insect pest which caused any serious trouble was the corn ear worm (*Heliothis obsoleta*) and it was found that this could be controlled by the planting of crops of maize at intervals of time so as to provide continuous green maize to attract the moths. If the cotton is planted early it generally escapes serious injury from the pest. In the case of later-planted cotton, if maize cannot be grown at the proper intervals, it may be advisable to dust the plants with calcium arsenate; tests on the use of this poison are to be conducted during the present season.

South Africa.—This section includes two reports on work done during the season 1925–26, (1) on the Cotton-breeding Station, Barberton, by F. R. Parnell, and (2) on the Experiment Station, Candover Estates, Magut, Natal, by F. S. Parsons. At Barberton, selection work is being carried out with special reference to resistance to the attack of the South African jassid (*Empoasca fascialis*). It was found that all the strains of Cambodia tested were practically immune to the pest.

An interesting account of the jassid is given, including its life-history, its effect on the cotton crop and the reasons for the different resistance of various strains of cotton. Much of the work reported in this section was carried out by J. L. Moerdyk, a holder of one of the Corporation's studentships, who has made a study of the relation of the hairiness of the under-surface of the leaves to jassid resistance, and has found that plants, such as Cambodia, the leaves of which are densely covered with long hairs, are immune or nearly so, whilst varieties like Watts' Long Staple, whose leaves bear fewer and shorter hairs, are very susceptible to attack. In general, the length of the hairs is a more important factor than the density.

At the Cotton Experiment Station, Candover Estate, the operations consisted of trials on the effect of phosphatic fertilisers, a standard variety test which unfortunately failed owing to drought, and spacing experiments. Observations were made on various insect pests, including the spiny boll-worm (*Earias insulana*), the Sudan boll-worm (*Diparopsis castanea*), the jassid, and the leaf-

eating beetle (*Syagrus rugifrons*), and various control methods were tested.

Swaziland.—A report on experimental work on cotton in Swaziland during the season 1925–26, by R. Cecil Wood, records experiments on spacing and time of planting, and a test of the value of kraal manure for cotton. A series of variety tests was carried out under standard conditions with Barberton Improved Bancroft, Rustenburg Improved Bancroft, Griffin, Zululand Hybrid and Uganda cottons; the Uganda variety gave the highest yield per acre and proved most resistant to jassid attack. Trials were made to determine the suitability for rotation with cotton of ground-nuts, sesamum seed, niger seed and safflower seed; the first three gave good results, but the safflower suffered from the drought and gave a poor yield. Observations were made on the insects which appeared on the cotton plants; these caused but little damage owing to the dryness of the season.

Southern Rhodesia.—A report is given by I. G. Hamilton and J. E. Peat on the Cotton-Breeding Station, Gatooma, for 1925–26, with an introductory note by G. S. Cameron. Trials were made with Improved Bancroft, Delfos, Acala, Trice and Express. The Bancroft cotton gave the lowest yields per acre. The Express and Delfos gave cotton of better length and uniformity than Acala and Trice. All the varieties proved susceptible to jassid, and it is suggested that crosses between Cambodia and selections of Express might give jassid-resistant strains. Some experiments were carried out in a bee-proof cage, a structure consisting of a light framework covered with mosquito netting; this contrivance keeps out insects liable to cause crossing as well as practically all the pests liable to injure the plants. It appears, however, that the development of the plants is retarded by their being grown in the cage.

Anglo-Egyptian Sudan.—A report on the work on cotton carried out in the Sudan by the Plant-Breeding Section in the season 1925–26 is contributed by M. A. Bailey. It consists of an introductory part giving an account of the organisation of the plant-breeding work, and a second part dealing in detail with the experimental operations and including particulars of an inspection of the cotton areas in the Gezira, at Tokar, at the Government Pump Stations on the Nile, and in the rain-cotton area of Singa, in Fung Province. The main crop of the cotton grown at Shambat Research Farm is a variety of Sakel, introduced from Egypt in 1922 and now referred to as "Shambat Sakel," which has been very favourably reported on in England. Variety tests were made with other types of

Sakel and with certain Upper Egyptian types. A number of small plots were also planted with Sakel types as well as with Sea Island types and certain hybrids. In order to investigate the effect of situation and climate on the cotton plants, a special study from the developmental standpoint is being made of an Egyptian Sakel and an American (Webber) type. In view of the importance of the purity of the seed-supply of the Sudan, strict Government control of the ginneries and of seed production is recommended. If suitable varieties can be found for the different districts, these should be grown exclusively in the particular districts, and the number of different types should be as few as possible. The ginneries should be so situated as to deal with only one type of cotton and all possible precautions should be taken to avoid mixing of seed-cotton in the gins. Suggestions are also made regarding the production and introduction of new varieties for certain areas and for the maintenance of a supply of pure, healthy seed when such varieties have been established.

Uganda.—A report on cotton experiments at the Serere Station is furnished by G. W. Nye, giving an account of the results obtained from October 1924 to the middle of 1926. Selection work has been carried out with special reference to quality of lint and yielding capacity. Certain selections, especially SG 15, a Nyasaland type, have yielded long-stapled cotton of excellent quality. A number of field experiments have been begun with the hope of obtaining an increased yield per acre, and experiments on date of sowing, spacing and behaviour of different varieties have been carried out. Germination tests have also been conducted. Samples of lint from most of the cotton-growing areas of the Protectorate have been examined and the majority of them were found to be deficient in regularity and length of staple.

Nyasaland.—Two reports are given on the work of cotton experiment stations in Nyasaland. The first, by H. C. Sampson, deals with the operations at the Makwapala Experiment Station for the year ending October, 1925. During the latter part of 1925 two small sub-stations were opened at Liwonde and Port Herald respectively, and a report on the work done at these as well as at Makwapala in the year ending October, 1926, is furnished by H. C. Ducker.

The chief obstacle to the progress of cotton cultivation in Nyasaland is the damage caused by three species of boll-worms, viz. the red, the American and the spiny; these pests are becoming increasingly serious on account of the fact that cotton is grown year after year on the same land. Attention has therefore been directed to

possible rotation crops with the object of ascertaining which would be feasible and profitable to grow. In 1925 trials were made with various rotations of cotton with tobacco, cereals and pulses, and also with fibre and oil-seed crops. All the cotton seed obtained from outside sources was treated with concentrated sulphuric acid, and the removal of the fuzz by this means was found to expedite germination.

In 1926, the study of rotation crops at Makwapala was continued. The first year's work at Liwonde consisted of trials of cotton and native food crops. The experience gained was sufficient to justify the abandonment of this station owing to its close resemblance to Makwapala, for although the conditions at Liwonde may not be exactly the same as those at Makwapala, such differences as exist are intermediate between those of the latter station and Port Herald.

At Port Herald trials were also made with cotton and native food crops. It was observed that the insect pests, which had been numerous and active up to July, began to decrease in numbers during that month, and by the middle of September had almost disappeared. It is therefore suggested that by means of suitable methods of cultivation it might be possible to " dodge the pests." The Port Herald Station is being extended both in respect of the area under cultivation and the scope of the work.

Of the various cottons grown at Makwapala, Liwonde and Port Herald, the best results have been obtained with a strain " B " of an American Upland variety, known as " Over the Top," which has proved practically immune to jassid attack. Seed of this strain is being multiplied and arrangements have been made to grow it at Makwapala and Port Herald in a series of spacing and time of planting trials. The seed is also to be distributed to estates in order to obtain sufficient cotton for a commercial test.

The treatment of cotton seed with sulphuric acid did not give quite such satisfactory results in 1926 as in 1925, and it appeared that although sound seed was not adversely affected, less vigorous seed was killed by the acid. Before proceeding further with this method, a laboratory study is to be made of the effect of subjecting the seed to acid of various strengths and for various periods.

Nigeria.—A report on the establishment of the Empire Cotton Growing Corporation's first seed farm in Northern Nigeria is given by J. Dawson Shepherd, O.B.E. The farm is situated at Daudawa, about sixty miles from Zaria on the motor road to Sokoto. An account is given of the clearing of the bush and breaking the ground, and information is furnished on the buildings, villages, water

supply and labour. Records have been compiled of the temperature and rainfall from March to September. An area of 120 acres was planted, 40 acres being devoted to cotton, 20 acres to guinea corn, 10 acres to ground-nuts and 50 acres to beans. It was considered that if the season were normal, the cotton would yield a crop a little above the native average, the guinea corn a little below the average, and the beans an average crop. The ground-nuts seem likely to prove the best crop on the farm.

West Indies.—In view of the establishment of the Empire Cotton Growing Corporation's cotton research station in Trinidad (see this BULLETIN, 1925, **23**, 454) the small experiment station at St. Vincent is being closed. A report on the work carried out at the St. Vincent Station during 1925–26 is contributed by L. H. Burd, M.A., Dip. Ag. (Cantab.). Results are given of spacing experiments with Sea Island cotton which indicate that 3 ft. 3 in. is probably the optimum distance between the rows with the plants 18 in. apart in the row. Other work includes flowering, bolling and shedding records, a comparative test on two varieties of Sea Island cotton, studies of the inheritance of corolla colour and petal length, observations on crinkled dwarf rogues and the so-called "man cottons," and records of plant development and crop analysis. A test was undertaken to determine the extent of natural crossing in Sea Island cottons, and data are recorded of fibre length, lint weight and seed weight of pure strains which have been under observation for four years.

Weather Damage.—Enormous losses are sustained each year in the United States owing to damage caused to raw cotton by its exposure to unfavourable weather conditions. An experimental study of this subject has been made by the United States Department of Agriculture, and the results, embodied in a paper entitled "Weather Damage to Cotton," by R. L. Nixon, Assistant Marketing Specialist, Bureau of Agricultural Economics, have been published as *Department Bulletin No.* 1438 (1926). The tests which have been carried out show clearly that the prevalent belief, especially on the part of farmers, that the exposure of bales of cotton to the weather does not reduce the value of the product, is erroneous.

Weather damage, i.e. damage caused by an excess of moisture, may occur in the field before the cotton is picked, or if the seed-cotton is left in heaps on the ground. Most of the damage, however, is entailed by the exposure of the bales in the yard of the ginnery, on river banks while awaiting shipment by river steamer, or on compress

and freight platforms. When a bale is left on the wet ground it rapidly absorbs moisture.

The damage takes place in two stages: (1) the cotton becomes mildewed and discoloured, although not necessarily weakened appreciably; (2) the fibre becomes decayed by the development of the fungi, its strength and spinning value being seriously reduced. If the process of decay is allowed to continue the fibre becomes worthless. Decay proceeds most rapidly in warm weather, and therefore under these conditions the most serious damage occurs.

Tests were conducted at five representative points in the cotton belt to determine the extent to which baled cotton suffers when exposed to weather. In each case a direct relationship was found between the amount of moisture absorbed and the resulting damage.

In order to protect baled cotton from weather damage, the bales must be kept from contact with the ground or other source of moisture. When it is not possible to warehouse the cotton immediately after ginning and baling, the bales should be stored in a dry place protected from the weather or, as a last resort, they should be edged up on poles and turned once a week.

It is also of importance that the cotton should be thoroughly matured and dried out before it is ginned. If ginned while wet, the cotton will probably be "gin cut" and otherwise injured, and the resulting bale will contain an excess of moisture which may give rise to serious damage.

Jute

In this BULLETIN (1922, **20**, 99) reference was made to experiments on jute cultivation which had been carried out in the "ganjar" tract of the United Provinces, which extends through considerable portions of the Kheri, Bahraich and Saipur Districts, and consists largely of the land lying in the angle between the Sarda and Gogra rivers and the low land on either bank. These experiments, which proved that the crop can be grown successfully in this tract, have been continued, and information on the results obtained and on the progress made in the development of jute as a commercial product of the district has now been given by T. R. Low, M.A., B.Sc., Deputy Director of Agriculture, Central Circle, United Provinces, in a paper entitled "Jute Cultivation in the United Provinces" (*Agric. Journ. India*, 1926, **21**, 380).

It has been found that if careful attention is paid to the selection of suitable land, and to the cultivation and growth of the jute, especially in its early stages, very fair crops can be obtained. In the "ganjar" irrigation is

not necessary if the seed is sown so early that sufficient moisture remains in the soil to give the young plants a good start, and under these conditions yields of over 25 maunds per acre have been produced. On the "uparhar" or higher land on the west bank of the Sarda river, jute sown during the rains gives a satisfactory yield, but the fibre is not equal to that grown in the "ganjar."

The area under cultivation increased from 90 acres in 1921 to 1,800 acres in 1925. There is no reason why the production of the fibre should not be greatly extended provided that satisfactory arrangements could be made to dispose of the crop locally at remunerative prices. In order to effect this, however, it is necessary that jute of a high grade should be produced, and specialists should therefore be employed to tour the jute areas and give instruction to the growers.

RUBBER

Yield from Budded Trees.—The results of comparative tapping experiments on seedlings and budded trees conducted on Tjinta Radja estate, East Coast of Sumatra, are recorded by Dr. C. Heusser in *Med. van het Alg. Proefsta. der A.V.R.O.S., Rubberser. No.* 54, 1926. Six groups of trees were used, viz. twenty seedlings raised from a cross between two high-yielding trees, nine seedlings grown from seed harvested from a selected tree, ten seedlings from good seed trees, and three groups of budded trees from selected mother trees, containing 35, 26 and 11 trees respectively. The seedlings were raised in 1919, and the age of the bark of all the trees tapped was approximately the same. Tapping was commenced in May, 1924, and continued to October, 1925. The average yields of dry rubber per tapping per tree in the six groups in the first year of tapping were as follows: (i) 11·2 grm., (ii) 7·4 grm., (iii) 6·6 grm., (iv) 8·3 grm., (v) 8·7 grm., (vi) 5·6 grm. During July and September, 1926, the experiment was continued, the number of trees in groups iii to vi being increased to 214, 109–112, 226–228 and 102–103 respectively. In these later experiments the hybrid trees, both of whose parents are known (group i), again gave the highest yield (29·2 grm. of dry rubber per tapping per tree during the September tapping). The seedlings from the selected tree (group ii) gave a corresponding yield of 20·0 grm., whilst those from ordinary seed trees (group iii) gave only 8·4 grm. The three groups of budded trees gave yields of 23·3, 20·5 and 15·3 grm. respectively. The conclusions drawn from these experiments are that good strains of budded trees are much better than seed-

lings from ordinary seed trees in the plantation, but that the average yield of seedlings from specially selected mother trees may prove to be equal to that from budded trees. It is pointed out, therefore, that, in future, seeds for planting should be obtained either from isolated seed gardens or from plantations consisting exclusively of buddings, preferably those from mother trees approved with regard to their seedlings.

High yields from budded trees are also recorded from Malaya (*Malayan Agric. Journ.*, 1926, **14**, 351).

Packing of Budding Wood.—When plant material to be used for budding has to be transported over long distances, it is important that it should arrive on the estate in the best possible condition. Experiments which have been conducted by Dr. J. G. J. A. Maas on the method of storing and packing Hevea shoots are of great interest in this connection (*Med. van het Alg. Proefsta. der A.V.R.O.S., Rubberser. No.* 52, 1926). His recommendations are as follows : If the budding wood is used within one week after cutting, young wood is as good as old wood ; it is advisable to coat the end of the young wood with paraffin, but this treatment is not necessary in the case of old wood ; banana leaf sheaths form a suitable and easy packing material ; the wood should be used as quickly as possible on arrival at the plantation. If more than one week elapses between cutting the wood and its actual use, only old wood should be employed ; the ends should always be paraffined ; the branches should be wrapped in small bundles in jute bags, rather than in banana leaf sheaths, which are liable to rot in transit ; the wrapped-up branches should be packed in closed chests, the spaces between the bundles being filled with moist charcoal ; on arrival on the estate the paraffin and a small piece of the end of the branch should be immediately removed. Whatever the time that may elapse between cutting the branches and their use, it is advisable to place them in water from the time of their arrival to the moment they are used, the water being renewed daily. In the case of wood cut in the afternoon, it is probably better to place it in water overnight and to pack the next morning.

Experiments conducted on the disinfection of budding wood before and after packing were inconclusive and it is pointed out that further experiments in this direction are desirable.

Rubber Diseases in the Amazon Valley.—An exhaustive survey of diseases affecting Hevea in the Amazon Valley was made by J. R. Weir during the expedition of the

United States Department of Agriculture and Commerce, which investigated the sources of crude rubber in the Amazon Valley (see this BULLETIN, 1926, **24**, 251). His results have been published in *Dept. Bull. No.* 1380, 1926, *U.S. Dept. Agric.* After a general discussion of the pathological conditions and plant sanitation obtaining in tropical America, the fungoid diseases found on Hevea in the course of the expedition are dealt with, arranged according to the part of the plant attacked, as well as injuries caused by phanerogamic plants and various physiological disturbances and abnormalities. Many of the diseases well known in the plantations of the Middle East were met with, including watery root rot (*Polyporus lignosus*), black line rot (*Ustulina zonata*), pink disease (*Corticium salmonicolor*), and die-back (*Diplodia theobromæ*). The South American leaf-blight (*Dothidiella ulei*) was found causing more or less damage to planted rubber at practically all the stations visited in the lower Amazon Valley, but the disease was less evident in the upper parts of the valley. The attack on young trees in the lower valley was sometimes very severe, and the author regards it as, without question, the most serious leaf disease of Hevea in the American tropics.

The Bulletin includes a very useful, annotated check-list of the fungi reported on Hevea in all parts of the world and a full bibliography, and is illustrated with many excellent reproductions of photographs.

TOBACCO

Australia, Victoria.—An account of the tobacco-growing industry of Victoria, by the Tobacco Expert of the State Department of Agriculture, is given in *Journ. Dept. Agric., Victoria* (1926, **24**, 633). At one time about 90 per cent. of the tobacco was produced by Chinese, but the quality of the leaf was poor. During the past ten years the industry has developed on new lines. The Chinese growers have been practically eliminated, better types and varieties of tobacco are grown and a system of flue-curing the leaf has been introduced. The standard of quality is maintained by the distribution of acclimatised seed from the Government Nursery, Wahgunyah, and up-to-date varieties from America and elsewhere are imported from time to time. The conditions in Victoria appear to be more suited to the production of pipe and cigarette tobacco than to that of cigar tobacco, which is the reverse of the position in Queensland.

It is estimated that Australian manufacturers use about 17,000,000 lb. of leaf annually, but of this quantity

only about 12 per cent. is produced in the Commonwealth. There is thus ample scope for the development of the local tobacco-growing industry. The area under the crop in Victoria is steadily increasing. In 1922-23 it was approximately 600 acres; it reached 1,000 acres in 1924-25, and it was estimated that a still larger area would be cultivated in the next season. The average area cultivated by one man is 7 acres, but there are several farms on which areas of from 20 to 70 acres are grown. The greater part of the tobacco is produced in the north-east of the State, along the valleys of the King and Ovens rivers, where it is grown on grey, sandy loams, which, with heavy dressings of superphosphate, give good results. The crop is a somewhat uncertain one, and is liable to fluctuations due to unsuitable seasons and the ravages of blue mould disease. Experienced growers consider that one good year in three may be expected, and in the remaining years partial crops may be obtained. The average yield of cured leaf per acre, taken over the last twenty years, is 600 lb., and in a good season yields of 1,000 lb. and up to a maximum of 1,500 lb. have been harvested.

Brown Root Rot.—A disease of tobacco characterised by a brown discoloration and decay of the root system, resulting in a stunting of the affected plants, is especially common in the Connecticut Valley, where it causes large losses to the tobacco industry. The disease, to which the name brown root rot has been given, also occurs to a serious extent in other tobacco-growing districts. The results of an investigation of the conditions under which the disease develops are recorded in *Dept. Bull. No.* 1410, 1926, *U.S. Dept. Agric.*

In many respects brown root rot has the appearance of a disease due to a parasitic organism, but no causal organism has so far been demonstrated to be definitely associated with the disease. The behaviour of brown root rot soils when exposed to desiccation and aeration is not favourable to a parasitic hypothesis, whilst the results of crop-rotation experiments, as well as the information gained from a survey of the disease in the field, indicate a crop relationship which is contradictory to an explanation based on parasitism.

The disease affects certain other crops, notably tomatoes, potatoes and certain legumes, but no lesions are apparent on such crops as maize, onions, cabbage and beets. A noteworthy feature of the disease is that those crops which are not affected or which are least affected favour the development or persistence of the disease in the soil,

whereas the commonly affected plants seem to favour the disappearance of the disease from the soil. This would appear to indicate that the disease may possibly be controlled by attention to the rotation or cropping system practised.

Gums and Resins

Copal.—An account of the copal industry in the island of Celebes by C. van de Koppel appears in *Tectona* (1926, **19**, 570). Copal trees (*Agathis alba*, Foxw.) are found in Celebes at altitudes from 150 ft. to 7,500 ft. The trees, which are no more rapid in growth than teak, attain the height of some 210 ft., and the largest trees, which are about 500 years old, have a diameter of about 7 ft. Although a small quantity of the copal is extracted from the ground most of the resin is collected by tapping the trees. The system of tapping employed by the natives, in which a large area of the bark is usually removed, has resulted in the death of many of the trees in the northwest of the Island. In the Malili district, where the industry is under the supervision of forest officers, the trees produce an average of 12 kilos. of copal a year. The copal collected on the Island is sorted at, and exported from, Macassar, together with copal obtained from other parts of the Dutch East Indies. The total amount of copal exported from Macassar in 1925 was 11,387 tons, of which 4,436·3 tons were produced in Celebes. The principal consumer of this product is the United States, which in that year received 65 per cent. of the output, whereas only 12 per cent. was exported to the United Kingdom. Macassar copal is known in commerce under the name of "Manila" copal. It is of better quality than the "Manila" copal originating from Singapore and the Philippines.

Storax.—Information concerning the production of storax (*Liquidambar orientalis*) in Anatolia, Asia Minor, is given in *L'Agronomie Coloniale* (1926, **15**, 165). The production of this resin is confined to the regions between Monghla, Kenydjeguiz, and Fethya. The trees resemble plane trees, but have a smaller leaf, and attain a height of about 26 ft. to 40 ft. They do not occur among other trees, but are found in colonies, the most important of which are situated in moist or swampy valleys, sometimes close to the sea. The storax is obtained when the trees are three or four years old, its collection being commenced early in May, when the trees are in full leaf and the secretions active. The surfaces are prepared in April by removing the outer layers of cork and sapwood from

opposite sides of the tree. The exposed surfaces are scraped every eight days until the middle of June with a knife having a curved blade, 4 cm. in length, then every four days, and during July and August every two days. The collection of the shavings is discontinued about the middle of November, when the rainy season commences. A four-year-old tree is thus worked each year for seven or eight months until the thickness between the two worked sides is reduced to 3 or 4 cm. It is then left for three or four years, and again worked for another five or six years before being finally cut down for firewood. The day's scrapings from the trees are each evening boiled with water, and then filtered through coarse cloth bags by the aid of a primitive press. The resin and water, which exude from the press, are collected in tubs where the resin, rising to the surface, is separated, and sold while still containing 25 to 30 per cent. of water. One foreman and four workers are able to deal with 500 trees a day. The workers are paid no fixed wage, but the foremen are given half the crop, which they generally resell to their managers at the current price in the district, which in 1925 was 80 piastres (about 1*s.* 9·6*d.*) an oke (2·8 lb.). Certain storax woods visited by the author of the article, with an area of 450 to 500 hectares, produced in a normal year 7,800 kilos. of the resin. The storax woods or forests of the country are owned either by large landowners or the Government, and the harvesting rights are leased at a minimum price of 19 piastres (about 5*d.*) for each oke of resin collected, which must not exceed a stipulated quantity. The resin is sold to Jews at Rhodes who free it from water and extraneous material, and are stated often to adulterate it with pine resin and oil of turpentine. The price obtained in 1925 was 100 piastres (about 2*s.* 3*d.*) an oke.

Storax possesses a strong aromatic odour, and is employed extensively as a fixative in perfumes, and to a smaller extent in medicine. The composition of the resin varies considerably; according to the *British Pharmacopœia* it must not contain less than 20 per cent. of cinnamic acid (free and combined).

TANNING MATERIALS

Mangroves of Madagascar.—Under the title "Écorces Tannifères de la Mangrove de Madagascar," an article is published in *Bull. de l'Agence Gén. des Colonies* (1926, **19**, 1205–1213, 1274–1280) by F. Heim de Balsac, with the collaboration of J. Maheu, which, so far as the structure of the barks is concerned, concludes the work on the subject (see this BULLETIN, 1926, **24**, 703). The anatomical

and histological features of a number of the Madagascar mangrove barks are described with the aid of diagrams.

Forestry and Timber

Gold Coast Timber Trees.—Dr. J. Burtt Davy, in the *Empire Forestry Journal* (1926, **5**, 276), publishes a list of identifications made at the Imperial Forestry Institute, Oxford, of a small collection of botanical specimens from the Gold Coast gathered by Mrs. R. Burnett. The specimens have enabled a number of native tree names to be correlated with the botanical species to which they are applied, and many of these names are additions to Dr. Chipp's preliminary *List of Trees, Shrubs and Climbers of the Gold Coast, Ashanti and Northern Territories* (1913). Three new species are recorded, viz. Atewa (*Calliandra* sp. nov.), Kwayemu akenka (*Limonia* sp. nov.) and Okura (*Albizzia* sp. nov.). The remaining new identifications, as recorded, are as follows:

Abru Koyin (Nyanti) (*Hura crepitans*, L.), Ajama (Ashanti) (*Musanga Smithii*, R.Br.), Akyere (*Phialodiscus unijugatus*, Radlk.), Amanseidua (*Cassia occidentalis*, L.), Apose (*Cnestis ferruginea*, DC.), Asawa (*Gossypium brasiliense*, Macf.), Bofwe (*Allanblackia leucantha*, Hutch. and Dalz.), Dani (Ashanti) (*Piptadenia africana*, Hook. f.), Deboo (*Anona muricata*, L.), Dubrefwo (*Mareya micrantha*, Muell. Arg.), Dwenwere (*Lecaniodiscus cupanioides*, Planch.), Jama (Twi) (*Alchornea cordifolia*, Muell. Arg.), Mantandua (*Bertiera montana*, Hiern.), Niankuma (*Myrianthus arboreus*, P. Beauv.), Obonawa (*Conopharyngia Cumminsii*, Stapf), Odanwoma (*Acacia Adansonii*, G. and P.), Odenya ? (*Pentaclethra macrophylla*, Bth.), Odwen (*Baphia nitida*, Lodd.), Oforto (*Glyphæa grewioides*, Hook. f.), Okuro (*Albizzia Brownii*, Walp.), Onwana (*Ricinodendron africanum*, Muell. Arg.), Oyankwren (*Ficus exasperata*, Vahl.).

A further series of additional identifications of specimens received at Oxford from the Gold Coast Forest Department is published in *Tropical Woods No.* 8, December, 1926. The species concerned are (Wassaw native names): Adidi (*Elæophorbia drupifera*, Stapf), Asunkruma (*Homalium* sp. nov.), Dukwa (*Lonchocarpus sericeus*, H.B.K.), Kotoprepre (*Berlinia heudelotiana*, Baill.), Pam-prama (*Corynanthe paniculata*, Welw.), Sesedua or Sese-hahamo (*Christiana africana*, DC.), Sisier (*Trema guineënsis*, Ficalho).

Timbers of Tropical America.—*Tropical Woods No.* 8 (December, 1926) contains an interesting series of short articles and notes on timbers. An account is given of

the tests initiated in 1924 by the Federal Bureau of Entomology at Panama with a view to determining the relative effectiveness of various preservatives in protecting wood, wood pulp and fibre boards against the attack of termites, and the powers of resistance to these pests offered by certain untreated tropical American woods. Three preliminary reports have been issued, and it is hoped to continue and enlarge the tests to cover a period of at least ten years. Four new species of trees from Central America are described, of which two are from British Honduras, namely *Bourreria mollis*, Standl. (said to be known in the Colony as "opay," "beh-eck" and "roble") and *Albizzia Hummeliana*, Britt. et Rose; the latter tree is known as "wild tamarind," a name also applied locally to species of Acacia. The use of the Mexican timber Amapa (*Tecoma pentaphylla*, Jus. = *Tabebuia pentaphylla*, Hemsl.) for interior work and flooring is discussed by E. Fritz. This species is widely distributed in Mexico and the West Indies.

Red Alder in the United States.—The Red Alder (*Alnus rubra*) is the principal hardwood of the Pacific North-west of the United States. It only represents a very small fraction of the total hardwood lumber of the country, but it owes its importance in the area mentioned to the local scarcity of other hardwoods. The occurrence and sylviculture of the tree, and the properties and utilisation of the timber, are dealt with in *Bulletin No.* 1437 (1926), *U.S. Dept. Agric.*

The tree ranges from southern Alaska to southern California, but its commercial importance is practically limited to Oregon and Washington. For the most part it occurs as a comparatively small tree in association with other moisture-loving trees, but in particularly damp situations it frequently forms pure stands of commercial-sized timber.

The wood is soft, rather light, somewhat weak, and moderately stiff; it does not shrink much; its resistance to shock and its durability are poor. Suitably stained it makes good imitation mahogany or walnut. Its principal use is in the manufacture of inexpensive chairs and other furniture, particularly for making turned parts where stiffness and ease of working are valuable.

Rate of Growth and Strength of Timber.—In the *Indian Forester* (1926, **52**, No. 12, pp. 619-625), L. N. Seaman discusses the relation of the rate of growth to strength in timber as exemplified by certain Indian woods. He

refers to the work on this subject carried out by Hale and Brophy, of the Forest Products Laboratories of Canada, with a number of Canadian coniferous timbers, and states that the facts recorded by those authors agree with the results of similar observations on Indian conifers, of which two are mentioned as examples, viz. *Picea Morinda* and *Pinus longifolia*. The author, however, enlarges the discussion to include dicotyledonous timbers, both ring porous (e.g. *Cedrela serrata*) and diffuse porous woods (e.g. *Anogeissus acuminata* and *Hopea parviflora*). The results so far obtained from the author's study of the question may be summarised as follows. The well-known variations in anatomical characters in conifers and dicotyledonous woods resulting from varying rates of growth are reflected in the density and strength of the wood, and different species have different optimum growth rates. In conifers the tendency is to produce the best material at the slower rates of growth. Ring porous dicotyledonous woods tend to produce their best material at more rapid growth rates because there is little difference in the amount of weak, open porous wood produced each year, the wide annual rings therefore containing a higher proportion of dense tissue. There would appear to be no evidence up to the present that growth rate has any material influence on the strength and density of diffuse porous dicotyledonous woods ; these species have a very uniform growth rate and such variation as occurs does not seem to be reflected in their structure.

The Cobweb Disease of Mahogany and Teak.—These interesting fungus diseases are described and illustrated by M. B. Schwarz in *Tectona* (Deel xix, 1926, Afl. 11/12, pp. 1040–1048). In the case of mahogany the undersides of branches attacked by the disease are covered with a strong, white mycelial cord which may ramify to form a network. The mycelium spreads to the petioles and thence to the whole underside of the leaves. The hyphæ enter the tissues of the branch and leaf, but up to the present fruiting bodies have not been detected. Leaves of teak when affected show a white mycelium on the underside originating from a thick, light-brown cord which traverses the main vein and leaf stalk. In this case also the branch and leaf tissues are penetrated by the hyphæ and there is no evidence of fruiting bodies. Both fungi apparently belong to the same group, and the author, after referring to Petch's working classification of similar "thread blights," concludes that both the mahogany and teak diseases in Java belong to Petch's class of Maras-

mioid thread blights, the hyphæ of which are characterised by the presence of "anker" cells. The teak disease in Ceylon, however, differs from the corresponding disease in Java in the absence of "anker" cells.

BIBLIOGRAPHY

Comprising the more important reports, articles, etc., on plant and animal products, contained in publications received in the Library of the Imperial Institute during the four months November 1926—February 1927.

The publications issued by the Governments of the Colonies and Protectorates can be obtained from or through the Crown Agents for the Colonies, 4, Millbank, Westminster, S.W.1. Applications for Dominion and Indian Government publications may be made to the Offices of the High Commissioners or Agents-General in London.

AGRICULTURE

General

Annual Report of the Director of Agriculture, Cyprus, for the Year 1925. Pp. 20, 9¾ × 6¼. (Nicosia: Government Printing Office, 1926.)

Scientific Reports of the Agricultural Research Institute, Pusa, 1925–26. Pp. 212, 10 × 7. (Calcutta: Government of India Central Publication Branch, 1926.) Price Rs.2-8 (4*s*. 6*d*.).

Report of the Agricultural Department, Bihar and Orissa, for the Period April 1, 1924, to March 31, 1925. Pp. 62, 9¾ × 6½. (Patna: Superintendent Government Printing, 1926.) Price Rs.2 As.8.

Report on the Operations of the Department of Agriculture, Burma, for the Year ended June 30, 1926. Pp. 3 + 3 + 27 + xiii, 9¾ × 6½. (Rangoon: Superintendent, Government Printing and Stationery, 1926.) Price R.1 (1*s*. 6*d*.).

Report of the Economic Botanist, Burma, Mandalay, for the Year ended June 30, 1925. Pp. 9, 9¾ × 6¼. (Rangoon: Superintendent, Government Printing, 1926.) Price As.4 (5*d*.).

Report on the Working of the Department of Agriculture of the Central Provinces, India, for the Year 1925–26. Pp. 43, 9¾ × 6¼. (Nagpur: Government Press, 1926.) Price R.1.

Report on the Operations of the Department of Agriculture, Madras Presidency, for the Year 1925–26. Pp. 79 + 41, 9¾ × 6¼. (Madras: Superintendent Government Press, 1926.) Price As.12.

Annual Report of the Agricultural Department, Mysore, for the Year 1924–25. Parts I and II. Pp. 93, 13 × 8¼.

Report on the Progress of Agriculture in Mysore. Pp. 155, 10 × 6½. (Bangalore: Government Press, 1926.)

Report on the Operations of the Department of Agriculture, Punjab, for the Year ending June 30, 1926. Part II, Vol. II. Annual Record of Experimental Work. Pp. 227, 13 × 8¼. (Lahore: Government Printer, 1926.) Price Rs.10 or 13*s*. 4*d*.

Annual Report on Agriculture, North Borneo, for 1925. *Supplement to the Official Gazette*, December 1, 1926, pp. 77–82.

Annual Report, Department of Agriculture, Forests and Fisheries, Palestine, 1925. Pp. 66, 13 × 8¼. Price P.T.10.

Annual Report of the Secretary for Agriculture, Union of South Africa for the year ended June 30, 1926. *Farming in South Africa* (1926, **1**, 290–364).

Annual Report of the Agricultural Department, Zanzibar, for the Year 1925. Pp. 22, $9\frac{3}{4} \times 6$. (Zanzibar: Government Printer, 1926.)

Report of the Minister of Agriculture for the Dominion of Canada for the Year ended March 31, 1926. Pp. 122, $9\frac{3}{4} \times 6\frac{1}{2}$. (Ottawa: Government Printer, 1926.) Price 25 cents.

Twentieth Annual Report of the Department of Agriculture, British Columbia, for the Year 1925. Pp. 109, $10\frac{1}{2} \times 7\frac{1}{4}$. (Victoria, B.C.: Government Printer, 1926.)

Annual Report of the Department of Agriculture of the Province of Ontario, 1925. Pp. 900, $9\frac{1}{2} \times 6\frac{1}{2}$. (Toronto: Government Printer, 1926.)

Report on the Agricultural Department, St. Vincent, for the Year 1925. Pp. 44, $13 \times 8\frac{1}{4}$. (Trinidad: Imperial Commissioner of Agriculture for the West Indies, 1926.) Price *6d.*

Annual Report of the Department of Agriculture, Western Australia, for the Year ended June 30, 1926. Pp. 46, $13 \times 8\frac{1}{4}$. (Perth: Government Printer, 1926.)

Report of the Chief of the Bureau of Plant Industry, United States Department of Agriculture for the Fiscal Year ended June 30, 1926. Pp. 16, 9×6. (Washington: Government Printing Office, 1926.)

Report on the Agricultural Experiment Stations, 1925, United States Department of Agriculture. Pp. 160, $9\frac{3}{4} \times 6$. (Washington: Government Printing Office, 1926.)

Agricultural Experiment Station, University of Florida, Report for the Fiscal Year ending June 30, 1925, with Bulletins, 172–174 and Press Bulletins, 362–367. Pp. 97 + 96 + 12 + iv, 9×6. (Gainesville, Florida: Experiment Station.)

Forty-fifth Annual Report of the New York Agricultural Experiment Station, for the Year ended June 30, 1926. Pp. 69, $8\frac{3}{4} \times 5\frac{3}{4}$. (Geneva, N.Y.: Experiment Station, 1926.)

Forty-Fourth Annual Report for 1924–25, Ohio Agricultural Experiment Station. *Bull. No.* 392. Pp. 100, 9×6. (Wooster, Ohio: Experiment Station, 1926.)

Rhode Island Agriculture, A Statistical Description. By R. B. Corbett. *Bull.* 206, *Rhode Island Agric. Exper. Sta.* Pp. 123, 9×6. (Kingston, Rhode Island: Experiment Station, 1926.)

Thirty-sixth Annual Report, Washington Agricultural Experiment Station, for the Fiscal Year ended June 30, 1926. *Bull. No.* 208, *Washington Agric. Exper. Sta.* Pp. 76, 9×6. (Pullman, Washington: State College, 1926.)

Report of the Hawaii Agricultural Experiment Station, 1925. Pp. 24, $9\frac{1}{4} \times 6$. (Washington: Government Printing Office, 1926.)

Twenty-fifth Annual Report of the Bureau of Agriculture, Philippine Islands, for the Year ending December 31, 1925. Pp. 123, $10 \times 7\frac{1}{4}$. (Manila: Bureau of Printing, 1926.)

A Brief Review of Agricultural Conditions in the Philippines and the Activities of the Bureau of Agriculture in 1925. By S. Youngberg. *Philippine Agric. Rev.* (1926, **19**, 87–141).

Annual Report of the Insular Experiment Station of the Department of Agriculture and Labour of Porto Rico, for the Fiscal Year 1924–25. Pp. 140, 9×6. (San Juan, Porto Rico: Bureau of Printing, 1926.)

Huitième Rapport de la Station Agronomique de la Guadeloupe, 1925–1926. Pp. 91, $9 \times 6\frac{3}{4}$. (Pointe-à-Pitre: A. and J. Lautric, 1926).

Über den gegenwärtigen Stand der Landwirtschaft in Guatemala. By K. Renz. *Tropenpflanzer* (1926, **29**, 471–479).

Die wichtigsten Kulturpflanzen der Tropen und Subtropen in ihrer Abhängigkeit von der Landschaft. By E. Kastens. *Tropenpflanzer* (1927, **30**, 11–27; *cont.*).

Crop Rotations and Soil Management for Eastern Canada. By E. S. Hopkins and W. C. Hopper. *Bull. No. 72, New Ser., Dept. Agric., Canada.* Pp. 57, $9\frac{3}{4} \times 6\frac{1}{2}$. (Ottawa: Minister of Agriculture, 1926.)

Research and the Land. An Account of Recent Progress in Agricultural and Horticultural Science in the United Kingdom. By V. E. Wilkins. Pp. 388, $8\frac{1}{2} \times 5\frac{1}{2}$. (London: H.M. Stationery Office, 1926.) Price 2*s*. 6*d*. (in paper covers), 3*s*. 6*d*. (in cloth).

Agricultural Research in 1925. Crops and Plant Breeding, by F. L. Engledow. Dairy Husbandry, by J. Mackintosh. Agricultural Economics, by C. S. Orwin. Agricultural Engineering, by B. J. Owen. Animal Nutrition, by C. Crowther. Soils and Manures, by Sir E. J. Russell. Veterinary Science, by Sir J. McFadyean. Pp. vii + 174. (London: Royal Agricultural Society of England, 1926.)

Agricultural Research in the British Empire. III. Agricultural Research in New Zealand. By J. S. Thompson and J. B. Orr. *Scottish Journ. Agric.* (1927, **10**, 12–17).

Wind Breaks and Shelter Belts. By A. S. Thornewill. *Rhodesia Agric. Journ.* (1926, **23**, 893–902).

The Relation of Meteorology to Agriculture. By R. B. Tennent. *New Zealand Journ. Agric.* (1926, **33**, 381–386).

International Yearbook of Agricultural Legislation, XVth Year—1925. English edition, 3rd Year. Pp. xxxv + 1104, $9\frac{1}{2} \times 6\frac{3}{4}$. (Rome: International Institute of Agriculture, 1926.)

Irrigation. By A. R. Clifton. *Journ. Dept. Agric., W. Austr.* (1926, **3**, 2nd ser., 392–414; 550–566, *cont.*).

Developing New Land under Irrigation. By R. P. Bean. *Popular Bull. No.* 136, *Washington Agric. Exper. Sta.* Pp. 28, 9 × 6. (Pullman, Washington: State College, 1926.)

An Economic Study of Irrigated Farming in Twin Falls County, Idaho. By B. Hunter and S. B. Nuckols. *Dept. Bull. No.* 1421, *U.S. Dept. Agric.* Pp. 74, 9 × 6. (Washington: Government Printing Office, 1926.) Price 15 cents.

Les Travaux publics de l'Indochine. Chap. III. L'Hydraulique agricole en Indochine. By A. Pouyanne. *Bull. Econ. Indochine* (1926, **29**, No. 178, pp. 223–251).

Élévation ou pompage des eaux d'irrigation. By E. Leplae. *Bull. Agric., Congo Belge* (1925, **16**, 275–301; 1926, **17**, 166–264).

The Use of Sulphuric Acid against Weeds and Certain Crop Parasites. By E. Rabaté. *Int. Rev. Sci. and Pract. of Agric.* (1926, **4**, N.S., 535–545).

Methods of Eradicating the Common Barberry (*Berberis vulgaris*, Linn.). By N. F. Thompson and W. W. Robbins. *Dept. Bull. No.* 1451, *U.S. Dept. Agric.* Pp. 44, 9 × 6. (Washington: Government Printing Office, 1926.) Price 20 cents.

Prickly Pear and Cochineal Insects. By J. C. Hutson. *Trop. Agric., Ceylon* (1926, **67**, 290–292).

The Water Hyacinth Pest. By W. C. Lester-Smith. *Trop. Agric., Ceylon* (1926, **67**, 327–329).

The Soil

Les terres rouges du Kontum-Darlac. By Y. Henry. *Bull. Econ. Indochine, Renseignements* (Aug. 1926, pp. 361–384).

The "Alkali" Soil Problem. By C. S. West. *Agric. Gaz., N.S.W.* (1926, **37**, 823–833).

Factors and Problems in the Selection of Peat Lands for Different Uses. By A. P. Dachnowski. *Dept. Bull. No.* 1419, *U.S. Dept. Agric.* Pp. 23, $9\frac{1}{4} \times 6$. (Washington: Government Printing Office, 1926.) Price 15 cents.

Statistical Data Relative to the Reclamation of a Salt-impregnated Area in a River Murray Orchard. By A. J. Perkins. *Journ. Dept. Agric., South Australia* (1927, **30**, 626–637).

On the Permeability of Clay Soils. By J. Wityn. *Int. Rev. Sci. and Pract. of Agric.* (1926, **4**, N.S., 554–588).

Properties of the Colloidal Soil Material. By M. S. Anderson and S. Mattson. *Dept. Bull. No.* 1452, *U.S. Dept. Agric.* Pp. 46, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 10 cents.

A Contribution to the Knowledge of the Determination of Soil Fertility. By J. Stoklasa. *Int. Rev. Sci. and Pract. of Agric.* (1926, **4**, N.S., 589–599).

The Significance of Nitrogen in Soil Organic Matter Relationships. By F. J. Sievers and H. F. Holtz. *Bull. No.* 206, *Div. of Soils, Washington Agric. Exper. Sta.* Pp. 43, 9 × 6. (Pullman, Washington: Experiment Station, 1926.)

Considerations on Manuring our Perennial Cultivations. By A. W. K. de Jong. *Communic., Gen. Exper. Sta., A.V.R.O.S., Gen. Ser., No.* 28. Pp. 20, 10¾ × 7½. (Medan: Varekamp & Co., 1926.)

Inoculation of Legumes and Nonlegumes with Nitrogen-fixing and Other Bacteria. By F. Löhnis and L. T. Leonard. *Farmers' Bull. No.* 1496, *U.S. Dept. Agric.* Pp. 27, 9½ × 6¼. (Washington: Government Printing Office, 1926.)

Green Manuring as a means of Maintaining and Improving Soil Fertility. By H. Wenholtz. *Farmers' Bull. No.* 156, *Dept. Agric., N.S.W.* Pp. 27, 9½ × 6¼. (Sydney: Government Printer, 1926.) Price 6*d*.

A Further Report on the Rate of Decomposition of Green Manures under Peradeniya Conditions. By A. W. R. Joachim. *Trop. Agric., Ceylon* (1926, **67**, 231–233).

The Analyses of some Green Manures. By A. W. R. Joachim. *Trop. Agric., Ceylon* (1926, **67**, 233–236).

The Effect of Lime and Fertilisers on the Potash Content of Soil and Crop. By J. G. Lipman, A. W. Blair and A. L. Prince. *Int. Rev. Sci. and Pract. of Agric.* (1926, **4**, N.S., 546–553).

Improvement of Soil Texture. Uses of Gypsum. By H. A. Mullett. *Journ. Agric., Victoria* (1926, **24**, 582–585).

Calcium Sulfate as a Soil Amendment. By M. H. Cubbon. *Mem.* 97, *Cornell Univ. Agric. Exper. Sta.* Pp. 51, 9 × 6¼. (Ithaca, New York: Cornell University, 1926.)

Insect Pests—General

A Preliminary List of Food-Plants of Some Malayan Insects. Compiled by B. A. R. Gater from the records obtained in the Entomological Laboratory from 1920 to 1926 by G. H. Corbett and B. A. R. Gater. *Bull. No.* 38, *Dept. Agric., F.M.S. and S.S.* Pp. 95, 10 × 6¾. (Kuala Lumpur, 1926.) Price 50 cents.

Miscellaneous Insects of 1925 [recorded on different crops in Malaya]. By G. H. Corbett and B. A. R. Gater. *Malayan Agric. Journ.* (1926, **14**, 242–265).

South Australian Plant Weevils. By A. M. Lea. *Journ. Dept. Agric., S. Australia* (1927, **30**, 582–598).

Fruit Fly (*Ceratitis capitata*). Trapping or Luring Experiments. By L. J. Newman. *Journ. Dept. Agric., Western Australia* (1926, **3**, 2nd Ser., 513–515).

The Oriental Peach Moth. By A. Peterson and G. J. Haeussler. *Dept. Circ.* 395, *U.S. Dept. Agric.* Pp. 27, 9 × 6. (Washington: Government Printing Office, 1926.) Price 10 cents.

Suggestions for the Control of Termites or White Ants in Buildings. By W. H. Patterson. *Bull. No.* 1, *Dept. Agric., Gold Coast.* Pp. 15, 9¾ × 6¼. (Accra: Government Printing Department, 1925.)

Akar Toeba (*Derris elliptica*). By S. C. J. Jochems. *Indische Culturen* (*Teysmannia*) (1926, **11**, 742–745).

Pyrethrum-Growing for Insecticidal Purposes (A Preliminary Report). By J. C. F. Fryer and R. Stenton. *Journ. Min. Agric.* (1926–27, **33**, 916–920).

Further Studies concerning the Aphiscidal Properties of Tobacco Dust. By H. C. Huckett. *Tech. Bull. No.* 121, *New York State Agric. Exper. Sta.* Pp. 29. (Geneva, N.Y.: Experiment Station, 1926.)

Trials of Tar-distillate Washes in the West Midlands. By S. G. Jary. *Journ. Min. Agric.* (1926, **33**, 753–761).

Fungoid Pests—General

A Summary of the Prevalence of Plant Diseases in the Dominion of Canada, 1920–1924. By. F. L. Drayton. *Bull. No.* 71, *New Ser. Dept. Agric., Canada.* Pp. 88, $9\frac{3}{4} \times 6\frac{1}{2}$. (Ottawa: Minister of Agriculture, 1926.)

Economic Plant Diseases in Kansas and their Control. By L. E. Melchers. *Circ.* 129, *Kansas Agric. Exper. Sta.* Pp. 23, $9 \times 6\frac{1}{4}$. (Manhattan, Kansas: Experiment Station, 1926.)

Wisconsin Studies Upon the Relation of Soil Temperature to Plant Disease. By L. R. Jones, J. Johnson and J. G. Dickson. *Res. Bull.* 71, *Wisconsin Agric. Exper. Sta.* Pp. 144, 9×4. (Madison, Wisconsin: State University, 1926.)

Philippine Mycological and Phytopathological Literature Index, I. By N. G. Teodoro. *Philippine Agric. Rev.* (1926, **19**, 275–291).

Ozonium Root Rot. By G. L. Peltier, C. J. King and R. W. Samson. *Dept. Bull. No.* 1417, *U.S. Dept. Agric.* Pp. 25 + 11 plates, $9\frac{1}{4} \times 6$. (Washington: Government Printing Office, 1926) Price 15 cents.

Mycological Notes. *Rhizoctonia bataticola* (Taub.) Butler. By W. Small. *Trop. Agric., Ceylon* (1926, **67**, 237–239).

Mycological Notes. Further Occurrences of *Rhizoctonia bataticola* (Taub.) Butler [on Tea, Citrus, Cocoa, *Hevea brasiliensis*, Chillies, etc.]. By W. Small. *Trop. Agric., Ceylon* (1926, **67**, 323–326).

The Preparation and Effectiveness of Basic Copper Sulphates for Fungicidal Purposes. By E. B. Holland, C. O. Dunbar and G. M. Gilligan. *Journ. Agric. Res.* (1926, **33**, 741–751).

Beverages

Yields of Cacao on Experiment Stations (Summary to end of 1925). By G. G. Auchinleck and C. H. Knowles. *Bull. No.* 4, *Dept. Agric., Gold Coast.* Pp. 44, $9\frac{3}{4} \times 6\frac{1}{4}$. (Accra: Government Printer, 1926.)

Cocoa. By-products and their Utilisation as Fertilizer Materials. By G. P. Walton and R. F. Gardiner. *Dept. Bull No.* 1413, *U.S. Dept. Agric.* Pp. 44, $9\frac{1}{4} \times 6$. (Washington: Government Printing Office, 1926.) Price 10 cents.

International Trade in Coffee. By M. L. Bynum. *Tr. Prom. Ser. No.* 37, *U.S. Bur. For. and Dom. Comm.* Pp. 103, $9\frac{1}{4} \times 6$. (Washington: Government Printing Office, 1926.) Price 20 cents.

Products of the Dutch East Indies. Coffee. Pp. 10, $9 \times 5\frac{3}{4}$. (Buitenzorg: Division of Commerce, Department of Agriculture, Industry and Commerce, 1926.)

Coffea robusta in Uganda. By T. D. Maitland. *Circ. No.* 14, *Dept. Agric., Uganda.* Pp. 11, $9\frac{3}{4} \times 6$. (Kampala: Department of Agriculture, 1926.)

The Cultivation and Preparation of Coffee Robusta. By J. D. Maitland. *Circ. No.* 15, *Dept. Agric., Uganda.* Pp. 12, $9\frac{3}{4} \times 6$. (Kampala: Department of Agriculture, 1926.)

Insects affecting Coffee in Trinidad and Tobago. By F. W. Urich. *Proc. Agric. Soc. Trinidad* (1926, **26**, 384–388.)

Coffee Diseases and their Control. By N. G. Teodoro and E. T. Gomez. *Philippine Agric. Rev.* (1926, **19**, 249–257).

Report on Tea Culture in Assam for the Year 1925. Pp. 5, 13 × $8\frac{1}{4}$. (Shillong: Assam Government Press, 1926.) Price As. 8 (1*s*.).

Products of the Dutch East Indies. Tea. Pp. 7, 9 × $5\frac{3}{4}$. (Buitenzorg: Division of Commerce, Department of Agriculture, Industry and Commerce, 1926.)

The Packing and Storage of Tea Seed. By C. J. Harrison. *Quart. Journ., Sci. Dept., Ind. Tea Assoc.* (1926, Part III, pp. 126–133).

Verpakking van Theezaad. By A. Keuchenius. *De Thee* (1926, **7**, 43–46).

Shade Trees [for Tea]. By H. R. Cooper. *Quart. Journ., Sci. Dept., Ind. Tea Assoc.* (1926, Part III, pp. 83–102).

De Polygonum-soorten der Theetuinen op Java. By B. H. Danser. *Med. Proefsta. voor Thee, No. XCVIII, Dept. Landb. Nijverh. en Handel.* Pp. 19 + 9 plates, $10\frac{1}{2}$ × $7\frac{1}{4}$. (Batavia: Ruygrok & Co., 1926).

Pruning in Relation to Disease [of Tea] in the Surma Valley. By A. C. Tunstall. *Quart. Journ., Sci. Dept., Ind. Tea Assoc.* (1926, Part III, pp. 103–107).

Over het Optreden van een nieuwe Luizenschimmel bij de Thee (*Nectria coccidophthora*, Zimmerman). By A. Steinmann. *De Thee* (1926, **7**, 49–52).

A new Septobasidium on Tea. By K. B. Boedijn. *Communic. from the General Exper. Sta. of the A.V.R.O.S., Gen. Ser. No.* 26, pp. 6–10. (Medan: Varekamp & Co., 1926.)

Thee in Briketten en Tabletten. By J. J. B. Deuss. *De Thee* (1926, **7**, 54–57).

Über der Bodenpflege auf den Teepflanzungen des südasiatischen Anbaugebietes. By L. W. Weddige. *Beiheft* 1, *zum Tropenpflanzer* (1926, **29**, No. 12).

Cereals

Report of the Dominion Cerealist, Dominion Experimental Farms, Department of Agriculture, for the Year 1925. Pp. 31 $9\frac{3}{4}$ × $6\frac{1}{2}$. (Ottawa: Minister of Agriculture, 1926.)

The Cadelle (*Tenebrioides mauritanicus*) [A pest of grain and grain products]. *Dept. Bull. No.* 1428, *U.S. Dept. Agric.* Pp. 41, 9 × 6. (Washington: Government Printing Office, 1926.) Price 10 cents.

The Cultivation of Barley. By E. Harrison. *Bull. No.* 6, *Dept. Agric., Kenya.* Pp. 7, $9\frac{3}{4}$ × $6\frac{1}{4}$. (Nairobi: Government Press, 1926.)

Maize in Kenya. By E. Harrison. *Bull. No.* 7, *Dept. Agric., Kenya.* Pp. 26, $9\frac{3}{4}$ × $6\frac{1}{4}$. (Nairobi: Government Press, 1926.)

Corn Production in Kansas. By S. C. Salmon. *Bull.* 238, *Kansas Agric. Exper. Sta.* Pp. 42, 9 × $6\frac{1}{4}$. (Manhattan, Kansas: Experiment Station, 1926.)

Selection of Maize for Seed and Show Purposes. By H. Wenholz. *Farmers' Bull. No.* 155, *Dept. Agric., N.S.W.* Pp. 40, $9\frac{1}{2}$ × $6\frac{1}{4}$. (Sydney: Government Printer, 1926.) Price 9*d*.

Insect Pests of the Maize Crop. By T. J. Anderson. *Bull. No.* 5, *Dept. Agric., Kenya.* Pp. 8, $9\frac{1}{2}$ × 6. (Nairobi: Department of Agriculture. 1926.)

The Root, Stalk and Ear Rot Diseases of Maize. Suggestions for their Control. By H. Wenholz and W. H. Darragh. *Agric. Gaz., N.S.W.* (1927, **38**, 39–49).

Rice-growing. Its Possibilities on the Murrumbidgee Irrigation Areas. By W. R. Watkins. *Agric. Gaz., N.S.W.* (1926, **37**, 741–748).

Le Riz à Madagascar (*cont.*). By J.-H. Leroy. *Agron. Col.* (1926, **15**, No. 106, 142–152; No. 108, 201–211).

L'Amélioration de la Riziculture à Madagascar. By J.-H. Leroy. *Riz et Riziculture* (1926, **2**; 69–87).

The Efficiency of Certain Nitrogenous Manures for Paddy. By L. Lord. *Trop. Agric., Ceylon* (1926, **67**, 285–289).

Rice Seed-Testing. By S. K. Mitra and P. M. Ganguly. *Agric. Journ., India* (1926, **21**, 421–428).

The Preliminary Testing of Pure Line Selections of Rice. By L. Lord. *Trop. Agric., Ceylon* (1926, **67**, 272–285).

Artificial Hybridization in Rice. By K. Ramiah. *Agric. Journ., India* (1927, **22**, 17–22).

Rice Diseases and their Control. By N. G. Teodoro and J. R. Bogayong. *Philippine Bur. Agric., Circ. No.* 183. *Phil. Agric. Rev.* (1926, **19**, 237–241).

Some Panicle Characters of Sorgo. By H. B. Cowgill. *Dept. Bull. No.* 1386, *U.S. Dept. Agric.* Pp. 37, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 20 cents.

Wheat-growing in the South-west and Riverina. By E. S. Clayton. *Agric. Gaz., N.S.W.* (1926, **37**, 715–724; 801–809; 867–877; 1927, **38**, 1–11; *cont.*).

The F.A.Q. and other Commercial Standards for Trading in Australian Wheat. By G. L. Sutton. *Journ. Dept. Agric., W. Austr.* (1926, **3**, 2nd ser., 299–329), also published as *Bull. No.* 188, *Dept. Agric., W. Australia.* Pp. 33, 9¾ × 6¼. (Perth: Government Printer, 1926.)

Report on the Quality for Breadmaking Purposes of Various Forms of Wheat Harvested in 1925, at the Trial Stations of the National Institute of Agricultural Botany. Pp. 16, 9½ × 7¼. (London: The Incorporated National Association of British and Irish Millers, 1926.)

Relation of Kernel Texture to the Physical Characteristics, Milling and Baking Qualities, and Chemical Composition of Wheat. By J. H. Shollenberger and D. A. Coleman. *Dept. Bull. No.* 1420, *U.S. Dept. Agric.* Pp. 16, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 5 cents.

Productiveness of Varieties of Winter Wheat in Illinois. By R. W. Stark. Pp. 35, 9¼ × 6. *Bull. No.* 276, *Illinois Agric. Exper. Sta.* Pp. 35, 9¼ × 6. (Urbana, Illinois: Experiment Station, 1926.)

Influence of Granulation on Chemical Composition and Baking Quality of Flour. By J. H. Shollenberger and D. A. Coleman. *Dept. Bull. No.* 1463, *U.S. Dept. Agric.* Pp. 35, 9 × 6. (Washington: Government Printing Office, 1926.) Price 10 cents.

Earcockle (*Tylenchus tritici*) and a Bacterial Disease (*Pseudomonas tritici*) of Wheat. By W. M. Carne. *Journ. Dept. Agric., Western Australia* (1926, **3**, 2nd Ser., 508–512).

Sugar

Improved Methods of Sugarcane Cultivation in North Bihar. By W. Sayer, Kasanji D. Naik, and Hardayal Singh Randhirot. *Agric. Journ., India* (1927, **22**, 5–16).

Some of the Promising Exotic Sugarcane Varieties of the Manjri Farm, Bombay. By Rao Bahadur P. C. Patil and V. G. Patwardhan. *Bull. No.* 125 *of* 1925, *Dept. Agric., Bombay.* Pp. 45, 9¾ × 6¼. (Bombay: Superintendent, Government Printing, 1926.) Price As.13 (1*s.* 3*d.*).

Report on The Sugar Industry. *Report No.* 66, *Board of Trade and Industries, Union of South Africa.* Pp. 50, 13 × 8¼. (Cape Town: Government Printers, 1926.)

Sugar-Cane Experiments in the Leeward Islands. Report on Experiments with Varieties of Sugar-cane conducted in Antigua, St. Kitts-Nevis, and Montserrat in the Season 1924–25. Pp. 39, 9¾ × 6. (Barbados: Imperial Commissioner of Agriculture for the West Indies, 1926.) Price 1*s.*

Report of Cane Farming Industry Committee. *Council Paper No. 70 of 1926, Trinidad and Tobago.* Pp. 71, 13 × 8¼. (Trinidad: Government Printing Office, 1926.) Price 2*s*. 3*d*.

Products of the Dutch East Indies. Java Sugar. Pp. 10, 9 × 5¾. (Buitenzorg: Division of Commerce, Department of Agriculture, Industry and Commerce, 1926.)

La produzione dello succhero di canna nelle colonie italiane. By G. Garbin. *Agricolt. Col.* (1926, **20**, 460–465).

The Cultivation of Sugar Cane in Peru. By A. H. Rosenfeld. *Intern. Sugar Journ.* (1926, **28**, 590–597).

Crops Subsidiary to Cane. By J. S. Dash. *Trop. Agric., W.I.* (1927, **4**, 6–7; 26–27).

Resistance in Sugar Beets to Curly-top. By E. Carsner. *Dept. Circ.* 388, *U.S. Dept. Agric.* Pp. 7, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 5 cents.

Eye Spot Disease on the Sugar Cane in Hawaii. *Int. Sugar Journ.* (1926, **28**, 585–589).

The Mosaic Disease of Sugarcane and its Control in Jamaica. By C. G. Hansford and P. W. Murray. With a Note on Streak Disease of Uba Cane. By H. H. Storey. *Microbiol. Circ. No.* 6, 1926, *Dept. Agric., Jamaica.* Pp. 39, 9¾ × 6¼. (Kingston: Government Printing Office, 1926.)

A Mosaic-like Disease of Sugarcane in the Central Provinces in 1926. By Jehangir Fardunji Dastur. *Agric. Journ., India* (1926, **21**, 429–432).

The Red-rot Disease of Sugar-Cane and its Control. By F. B. Serrano and S. L. Marquez. *Philippine Bur. Agric., Circ. No.* 194. *Phil. Agric. Rev.* (1926, **19**, 263–265).

Some Discoveries in the Treatment of Sugar Beet [Desiccation Methods]. By B. J. Owen, L. F. Manés and J. L. Dougan. *Journ. Min. of Agric.* (1926–27, **33**, 986–996).

Root Crops

Products of the Dutch East Indies. Cassava Products. Pp. 8, 9 × 5¾. (Buitenzorg: Division of Commerce, Department of Agriculture, Industry and Commerce, 1926.)

Potato Growing in Missouri. By J. T. Quinn. *Bull.* 240, *Missouri Agric. Exper. Sta.* Pp. 31, 9 × 6. (Columbia, Missouri: Experiment Station, 1926.)

The Sweet Potato. By A. R. Hilton. *Journ. Dept. Agric., S. Australia* (1926, **30**, 382–386)

Trials with Sweet Potatoes in the Metropolitan Area. By J. Douglass. *Agric. Gaz., N.S.W.* (1926, **37**, 755–759).

Further Crop Records of Yams. By J. N. Milsum. *Malayan Agric. Journ.* (1926, **14**, 394–396).

Fruits

Fruitgrowing in Queensland. A General Review. By A. H. Benson. *Queensland Agric. Journ.* (1927, **27**, 18–26.)

Management Problems of Co-operative Associations Marketing Fruits and Vegetables. By A. W. McKay and W. J. Kuhrt. *Dept. Bull. No.* 1414, *U.S. Dept. Agric.* Pp. 51, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 10 cents.

An Economic Study Concerning the Operations of Fruit and Vegetable Shippers in Western New York. *Bull.* 453, *Cornell Agric. Exper. Sta.* Pp. 67, 9 × 6. (Ithaca, New York: Cornell University, 1926.)

Fruit Drying for Amateurs and Beginners. By G. Quinn. *Journ. Dept. Agric., S. Australia* (1926, **30**, 514–527).

Notes on Sulphuring Fruits Prior to Drying. By G. Quinn. *Journ. Dept. Agric., S. Australia* (1926, **30**, 500–510).

The Codling Moth. Measures necessary more effectively to control the Pest. By F. W. Pettey. *Bull. No.* 9, *Dept. Agric., Un. S. Afr.* Pp. 15, 9¼ × 6. (Pretoria: Government Printing Office, 1926.)

Results of some Experiments carried out at the Blackwood Experimental Orchard for the Control of Codlin Moth. By R. Fowler. *Journ. Dept. Agric., S. Australia* (1926, **30**, 240–251).

The San José Scale (*Aspidiotus perniciosus*). By L. J. Newman. *Journ. Dept. Agric., W. Austr.* (1926, **3**, 2nd Ser., 365–371).

Control of Brown-rot in Stone-fruits. Recent Experiments at Henderson. *New Zealand Journ. Agric.* (1926, **33**, 170–173).

Root Rot of Fruit Trees due to *Armillaria mellea.* By W. M. Carne. *Journ. Dept. Agric., W. Austr.* (1926, **3**, 2nd Ser., 429–432).

Picking, Packing and Shipping Apples. By T. J. Talbert and F. S. Merrill. *Circ.* 147, *Missouri Agric. Exper. Sta.* Pp. 44, 9 × 6. (Columbia, Missouri: Experiment Station, 1926.)

Packing Apples in Barrels and Boxes. By A. Fulton. *Bull. No.* 69, *New Ser., Dept. Agric., Canada.* Pp. 38, 9¾ × 6½. (Ottawa: Minister of Agriculture, 1926.)

The Ripening, Storage and Handling of Apples. By J. R. Magness and others. *Dept. Bull. No.* 1406, *U.S. Dept. Agric.* Pp. 64, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 20 cents.

Picking Maturity of Apples in Relation to Storage. By J. R. Magness, H. C. Diehl, and M. H. Haller. *Dept. Bull. No.* 1448, *U.S. Dept. Agric.* Pp. 19, 9 × 6. (Washington: Government Printing Office, 1926.) Price 5 cents.

Studies of the Epidemiology and Control of Apple Scab. By G. W. Keitt and L. K. Jones. *Res. Bull.* 73, *Wisconsin Agric. Exper. Sta.* Pp. 104, 9 × 6. (Madison, Wisconsin: State University, 1926.)

Bitter Pit in Apples. A Review of the Problem. By A. J. M. Smith. *Spec. Rep. No.* 28, *Food Investig., Dept. Sci. and Indust. Res.* Pp. 24, 9¾ × 6¼. (London: H.M. Stationery Office, 1926.) Price 1*s.*

Apple Physiology. Growth, Composition and Fruiting Responses in Apple Trees. By R. H. Roberts. *Res. Bull.* 68, *Wisconsin Agric. Exper. Sta.* Pp. 72, 9 × 6. (Madison, Wisconsin: Experiment Station, 1926.)

Pollination of the Avocado. By T. R. Robinson and E. M. Savage. *Dept. Circ.* 387, *U.S. Dept. Agric.* Pp. 16, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 5 cents.

Dusting with Calcium Cyanide for Banana Thrips Control. By J. L. Froggatt. *Queensland Agric. Journ.* (1927, **27**, 67–72).

Taxonomic Aspect of Tropic Citriculture. By T. Tanaka. *Philippine Agric. Rev.* (1926, **19**, 179–184).

The Grape Fruit in Ceylon. *Trop. Agric., Ceylon* (1926, **67**, 193–194).

Die Tahiti-Limonelle, eine zum Anbau empfehlenswerte Varietät. By J. C. Th. Uphof. *Tropenpflanzer* (1926, **29**, 425–427).

Fumigation of Citrus Trees. The 1926 Trials with Calcium Cyanide. By R. J. Benton. *Agric. Gaz., N.S.W.* (1927, **38**, 77–80).

Citrus Pit (*Pseudomonas citriputeale*). By W. M. Carne. *Journ. Dept. Agric., W. Austr.* (1926, **3**, 2nd Ser., 378–381).

Cranberry Disease Investigations on the Pacific Coast. By H. F. Bain. *Dept. Bull. No.* 1434, *U.S. Dept. Agric.* Pp. 28, 9 × 6. (Washington: Government Printing Office, 1926.) Price 5 cents.

Some Physical and Chemical Changes occurring during the Ripening of Grapes (Second Paper). By P. R. v.d. R. Copeman and G. Frater. *Sci. Bull. No.* 50, *Dept. Agric., Un. S. Afr.* (*Div. of Chem. Ser. No.* 67). Pp. 54, 9½ × 6. (Pretoria: Government Printing Office, 1926.) Price 9*d.*

Downy Mildew of the Vine (*Plasmopara viticola*) in New Zealand. By J. C. Woodfin. *Bull. No.* 127, *New Zealand Dept. Agric.* Pp. 7.

9¾ × 6. (Wellington: Government Printer, 1926.) (Reprinted from *New Zealand Journ. Agric.*, July, 1926.)

Root Disease on Lanzones (*Lansium domesticum*). By J. R. Bogayong. *Philippine Bur. Agric., Circ. No.* 193. *Phil. Agric. Rev.* (1926, **19**, 259–261).

Nut-Tree Propagation. By C. A. Reed. *Farmers' Bull. No.* 1501, *U.S. Dept. Agric.* Pp. 46, 9 × 6. (Washington: Government Printing Office, 1926.) Price 10 cents.

Fodders and Forage Crops

Report of the Division of Forage Plants, Dominion Experimental Farms, Department of Agriculture, Canada, for the years 1924 and 1925. Pp. 41, 9¾ × 6½. (Ottawa: Government Printer, 1926.)

Grasses and Forage Crops in Jamaica. By W. L. Barnett. *Misc. Circ. No.* 2, *Dept. Sci. and Agric., Jamaica.* Pp. 16, 9½ × 6.

Stock Foods. By J. C. Brünnich. *Queensland Agric. Journ.* (1926, **26**, 180–211).

The Relation Between Net Energy Value and Digestibility. By F. J. Warth. *Agric. Journ., India* (1926, **21**, 447–451).

Fodders and Supplementary Forage Crops for Dairy Farmers. By T. H. Patterson. *Bull. No.* 126, *New Zealand Dept. Agric.* Pp. 8, 9¾ × 6. (Wellington: Government Printer, 1926.)

The Establishment of Useful Fodder Plants and Elimination of Worthless Scrub by the Use of Phosphatic Fertilisers on Phosphorus-deficient Soils. By A. B. Adams. *Journ. Dept. Agric., Western Australia* (1926, **3**, 2nd Ser., 496–500.)

The Grasslands of New Zealand. Series II. North Island Hill Country. By E. Bruce Levy. Grasses and Clovers for Hill Country. (1) Perennial Rye-grass (*Lolium perenne*); (2) Cocksfoot (*Dactylis glomerata*); (3) *Poa pratensis;* (4) Crested Dogstail (*Cynosurus cristata*); (5) *Paspalum dilatatum. New Zealand Journ. Agric.* (1926, **32**, 301–310; 1926, **33**, 73–84; 145–154; 244–251; 361–378).

Pasture Studies. By R. G. Wiggans. *Mem.* 104, *Cornell Agric. Exper. Sta.* Pp. 59, 9 × 6. (Ithaca, New York: Cornell University, 1926)

Organisation et exploitation d'un élevage au Congo Belge. By E. Leplae. Chap. II, Possibilité d'un Pâturage de Brousse. Chap. III, Procêdes d'Amélioration des Pâturages naturels. Chap. IV, Modes d'Utilisation des Pâturages de Brousse. *Bull. Agric., Congo Belge* (1925, **16**, 446–498).

Silage, Ensilage and Silos. By G. L. Sutton. *Journ. Dept. Agric., Western Australia* (1926, **3**, 2nd Ser., 467–471, *cont.*).

Sunflower Compared with Corn as a Silage Crop for New York. By R. G. Wiggans. *Bull.* 456, *Cornell Agric. Exper. Sta.* Pp. 29, 9 × 6. (Ithaca, New York: Cornell University, 1926.)

Hubam Sweet Clover (*Melilotus alba*). By E. W. Fenton. *Journ. Min. Agric.* (1926, **33**, 834–836).

The Clover Root Borer. By L. P. Rockwood. *Dept. Bull. No.* 1426, *U.S. Dept. Agric.* Pp. 48, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 10 cents.

Anthracnose as a Cause of Red Clover Failure in the Southern Part of the Clover Belt. By A. J. Pieters and J. Monteith, Jr. *Farmers' Bull. No.* 1510, *U.S. Dept. Agric.* Pp. 17, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 5 cents.

La Plata-Luzerne. By A. Boerger. *Tropenpflanzer* (1926, **29**, 386–395, 438–455).

Irrigated Alfalfa in Washington. By H. P. Singleton. *Bull. No.* 209, *Washington Agric. Exper. Sta.* Pp. 15, 9 × 6. (Pullman, Washington: State College, 1926.)

Fertilizer Experiments with Alfalfa conducted at the United States Yuma Field Station, Bard, Calif., 1919 to 1925. By H. L. Westover and E. G. Noble. Pp. 10, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 5 cents.

Feeding Trials with Russian Sunflower Seed Cake. *Scottish Journ. Agric.* (1927, **10**, 71–73).

Two Recent Cases of Plant Poisoning among Stock. Strathmore Weed (*Pimelia prostrata*) and Ngaio (*Myoporum lætum*). By W. M. Webster. *New Zealand Journ. Agric.* (1926, **33**, 102–105).

The Common Chokeberry (*Prunus demissa*), as a Plant Poisonous to Sheep and Cattle. By C. E. Fleming, M. R. Miller and L. R. Vawter. *Bull. No.* 109, *Nevada Agric. Exper. Sta.* Pp. 30, 9¼ × 6. (Reno, Nevada: University of Nevada, 1926.)

Ragwort (*Senecio Jacobæa*) and its Relation to Winton Disease. By E. Atkinson. *New Zealand Journ. Agric.* (1926, **33**, 159–169).

Spices

Notes on Condiments used in Curries. By J. N. Milsum. *Malayan Agric. Journ.* (1926, **14**, 266–271).

Some Tests in the Culture of Peppers (*Capsicums*). By J. W. Lloyd. *Bull. No.* 274, *Illinois Agric. Exper Sta.* Pp. 6, 9¼ × 6. (Urbana, Illinois: Experiment Station, 1926.)

Oils and Oil Seeds

Chinese Wood Oil and Candlenut Oil. By B. J. Eaton and C. D. V. Georgi. *Malayan Agric. Journ.* (1926, **14**, 358–360).

L' "Aouara" (*Astrocaryum* sp.), Palmier oléifère de Guyane. Étude du fruit, de la graine et des graisses qu'ils fournissent. By F. Heim de Balsac, G.-S. Dagand, J. Maheu and H. Heim de Balsac. *Bull. Ag. Gén. des Colonies* (1926, **19**, 1180–1198, *cont.*).

Products of the Dutch East Indies. Coprah. Pp. 8, 9 × 5¾. (Buitenzorg: Division of Commerce, Department of Agriculture, Industry and Commerce, 1926.)

Further Observations on the Malaysian Coconut Zygænid (*Artona catoxantha*, Hamps.). By B. A. R. Gater. *Malayan Agric. Journ.* (1926, **14**, 304–320).

Further Remarks on *Ptychomyia remota*, Ald., a Parasite of *Artona catoxantha*, Hamps. By B. A. R. Gater (*loc. cit.* pp. 321–339).

A Preliminary Note on "Chalcid No. 1594," a Parasite of *Ptychomyia remota*, Ald. By B. A. R. Gater (*loc. cit.* pp. 340–348).

Control of the Coconut Caterpillar (*Nephantis serinopa*), by its Parasites. By Rao Sahib Y. Ramachandra Rao. *Agric. Journ. India* (1926, **21**, 452–459).

Refining Method for Crude Cottonseed Oil. By C. B. Cluff. *Journ. Oil and Fat Indust.* (1926, **3**, 376–381).

The Ground Nut, or Monkey Nut. By C. Mainwaring. *Rhodesia Agric. Journ.* (1926, **23**; 988–994).

The Peanut (*cont.*). By H. Wenholz and G. Nicholson. *Agric. Gaz., N.S.W.* (1926, **37**, 762–768; 842–846).

Field Experiments with Peanuts. Grafton Experiment Farm. By G. Nicholson. *Agric. Gaz., N.S.W.* (1927, **38**, 69–73).

L'Huile d'Anda-assu (*Joannesia princeps*). By H. Jumelle. *Les Matières Grasses* (1926, **18**, 7695–7696).

The Fatty Oils of Sweet Clover Seed. I. *Melilotus albus*. By B. A. Dunbar and C. F. Wells. *Journ. Oil and Fat Indust.* (1926, **3**, 382–385).

Estudo sobre os Palmares do Vale e do Delta do Rio Muconga. By J. Gossweiler and A. A. Monteiro do Amaral. *Publ. Div. V, Missão de Oleaginosos, Fomento Geral de Angola.* Pp. 30, 9 × 6. (Lisbon: Agência Geral das Colonias, 1926.)

Le Palmier à Huile au Congo portugais et dans l'Enclave de Cabinda. By P. Jannssens. *Publications de la Direction de l'Agriculture, Ministère des Colonies, Belgium.* Pp. 66, 9½ × 6. (Brussels: Imprimerie Industrielle et Financière, 1927.)

Résultats obtenus par sélection primaire des Palmiers de la région de Bingerville. By A. Houard. *Agron. Col.* (1926, **15**, No. 107, 171–182).

La Sélection des Palmiers à Huile à la Station expérimentale de la Mé. By A. Houard. *Bull. Ag. Gén. des Colonies* (1926, **19**, 1256–1264; *cont.*).

Contribution à l'étude chimique des fruits de l' *Elæis guineensis.* By F. M. Dyke and F. O. James. *Bull. Agric., Congo Belge* (1925, **16**, 516–527).

A propos du palmier à oreilles *Elaeis Poissonii,* E. Annet. By L. Tihon. *Bull. Agric., Congo Belge* (1925, **16**, 528–533).

Cultuur en selectie van den oliepalm in Nederlandsch-Indië. By J. G. J. A. Maas. *Bull. Agric., Congo Belge* (1926, **17**, 265–274).

Pollination Experiments with Oil Palms. By J. N. Milsum and E. A. Curtler. *Malayan Agric. Journ.* (1926, **14**, 384–393).

La Fécondation artificielle du Palmier à Huile. By J. Lavergne. *Agron. Col.* (1926, **15**, No. 106, 129–141).

Le Traitement Mécanique des Fruits du Palmier à Huile. *Bull. Matières Grasses, Inst. Col., Marseille,* 1926, Nos. 8/9, pp. 238–242.

Contribution à l'étude des animaux nuisibles à l'Elæis. Les Tisserins. By R. P. H. Vanderyst. *Bull. Agric., Congo Belge* (1925, **16**, 334–539).

Chemical Composition of Okra Seed. By J. O. Halverson and B. Naiman. *Journ. Oil and Fat Indust.* (1926, **3**, 386–387).

Olivicoltura nella Tunisia e nella Libia. By A. Maugini. *Agricoltura Coloniale* (1927, **21**, 1–5; *cont.*).

Essais divers sur le Beurre de Karité (*cont.*). By G. de Belsunce. *Bull. Matières Grasses, Inst. Col., Marseille,* 1926, Nos. 8/9, pp. 195–198; (*cont.*)

Soybeans—A new Farm Crop. By H. Wenholz. *Agric. Gaz., N.S.W.* (1926, **37**, 915–920).

Essential Oils

Annual Report on Essential Oils, Synthetic Perfumes, etc. Published by Schimmel & Co. English edition 1925. Pp. 214, 8¾ × 6. (Miltitz, near Leipzig.)

Products of the Dutch East Indies. Essential Oils. Pp. 9, 9 × 5¾. (Buitenzorg: Division of Commerce, Department of Agriculture, Industry and Commerce, 1926.)

The Rose and the Rose Industry in Bulgaria. By As. Zlataroff. *La Parfumerie Moderne* (1926, Dec., pp. 297–302).

Fibres

Report of the Chief Officer, Division of Economic Fibre Production, Dominion Experimental Farms, Department of Agriculture, Canada, for the Year 1925. Pp. 19, 9¾ × 6½. (Ottawa: Government Printer, 1926).

The Fiber Standardization Law. Seventh Philippine Legislature, First Session. S. No. 167 [No. 3263]. An Act to amend Certain Sections of Article 3 of Chapter 46 of Act numbered 2,711, known as the Administrative Code, making the Provisions of Said Act more Effective and for Other Purposes. *Philippine Agric. Rev.* (1926, **19**, 207–215).

The Government of the Philippine Islands. Fiber Standardization Board. Philippine Fiber Inspection Service. Manila, July 1, 1926. Administrative Order No. 1. Subject: Regulations Governing the Grading, Baling, Marking and Description of Philippine Fibers. *Philippine Agric. Rev.* (1926, **19**. 217–235).

Broom Fibre Growing. By T. A. J. Smith. *Journ. Agric., Victoria* (1926, **24**, 659–663).

Broom Millet. Possibilities in the South-West [of Western Australia]. By G. K. Baron-Hay. *Journ. Dept. Agric., W. Austr.* (1926, **3**, 2nd Ser., 442–446; 475–479).

Products of the Dutch East Indies. Kapoc. Pp. 7, 9 × 5¾. (Buitenzorg: Division of Commerce, Department of Agriculture, Industry and Commerce, 1926.)

The Kapok Industry of Java. By V. C. Bartolome. *Philippine Agric. Rev.* (1926, **19**, 191–199).

Overzicht van de dierlijke Vijanden van de Kapokcultuur op Java. By J. C. van der Meer Mohr. *De Indische Culturen* (*Teysmannia*) (1927, **12**, 4–13; 62–69).

Kapok in the Philippines. *Phil. Agric. Rev.* (1926, **19**, 185–189).

Abaca Heart-Rot and Bunchy-Top Diseases and their Control. By N. G. Teodoro and F. B. Serrano. *Philippine Bur. Agric., Circ. No.* 190. *Phil. Agric. Rev.* (1926, **19**, 243–247).

Artificial Silk. By T. Brough. *Journ. Roy. Soc. Arts* (1926, **75**, 97–113).

Étude de la fibre du Laos dénommée " Po Lom Pom " (*Thespesia Lampas*, Dalz. et Gibs.). By J. Dantzer. *Agron. Col.* (1926, **15**, No. 107, 161–164).

On the Question of the Standardisation of Wool in the Preparation of International Wool Statistics. By H. Henseler. *Int. Rev. Sci. and Pract. of Agric.* (1926, **4**, N.S., 513–534).

Official Standards of the United States for Grades of Wool and Wool Top. *Service and Regulatory Announcements No.* 100 (*Agricultural Economics*), *U.S. Dept. Agric* Pp. 12, 9¼ × 6. (Washington: Government Printing Office, 1926).

Effect of Feeding and Management of Sheep on the Tensile Strength and Elasticity of Wool. By W. E. Joseph. *Journ. Agric. Sci.* (1926, **33**, 1073–1089).

Products of the Dutch East Indies. Plaited Hats. Pp. 6, 9 × 5¾. (Buitenzorg: Division of Commerce, Department of Agriculture, Industry and Commerce, 1926.)

Cotton

Cotton Production and Distribution. Season of 1925–26. *Bull.* 160, *Bur. Census, U.S. Dept. Comm.* Pp. 65, 9 × 6. (Washington: Government Printing Office, 1926.) Price 10 cents.

Cotton Cultivation in Sind. By Khan Bahadur G. A. Rehman. *Bull. No.* 128 *of* 1926, *Dept. Agric., Bombay.* Pp. 36, 9¾ × 6¼. (Bombay: Superintendent of Government Printing, 1926.) Price As. 3 (3*d.*).

Length of Fibre and Ginning Percentage in Indian Cottons. By Rama Prasada. *Agric. Journ., India* (1926, **21**, 433–446).

Variability in the Ginning Percentages in Crosses of Indian Cottons. By Rama Prasada. *Agric. Journ., India* (1927, **22**, 23–29).

The Native Cotton Industry and its Relation to Rural Economy in the British Colonies of East Africa. By H. C. Sampson. *Emp. Cotton Grow. Rev.* (1927, **4**, 29–35).

Cotton in Swaziland. By R. C. Wood. *Emp. Cotton Grow. Rev.* (1927, **4**, 13–19).

Cotton Growing in Queensland. By W. G. Wells. *Queensland Agric. Journ.* (1927, **27**, 33–36).

La Production du Coton dans le bassin de la Méditerranée. By G. Carle. *Coton et Culture Cotonnière* (1926, **1**, 25–48).

Le Coton et sa Production Coloniale. By J. Dybowski. *Coton et Culture Cotonnière* (1926, **1**, 15–24).

L'Industrie Cotonnière et l'Effort de Production du Coton dans les

Colonies Françaises. By R. Angliviel de la Beaumelle. *Coton et Culture Cotonnière* (1926, **1**, 161–167).

Études sur les Cotons du Maroc. La Production du Coton au Maroc. By E. Miège. Étude technologique de Cotons du Maroc. By F. Heim de Balsac and O. Rœhrich. *Coton et Culture Cotonnière, Travaux de la Section des Cotons* (1926, **1**, 39–76).

Étude technologique de Cotons de Tunisie. By Heim de Balsac, O. Rœhrich and Ch. Pontillon. *Coton et Culture Cotonnière, Travaux de la Section des Cotons* (1926, **1**, 191–210).

La Production du Coton dans les Colonies Portugaises. By C. de Mello Geraldes. *Coton et Culture Cotonnière* (1926, **1**, 168–171).

Le Cotonnier en Perse. By Ahmed H. Adle. *Coton et Culture Cotonnière* (1926, **1**, 172–179).

Die Baumwollkultur in Brasilien (*cont.*). By Th. Bühler. *Tropenpflanzer* (1926, **29**, 379–385; 428–438; 484–495).

A Note on the Vegetative Propagation of Cotton Plants. By S. C. Harland. *Emp. Cotton Grow. Rev.* (1927, **4**, 53–55).

The Cotton Hopper, or So-called "Cotton Flea." By W. D. Hunter. *Dept. Circ.* 361, *U.S. Dept. Agric.* Pp. 15, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 5 cents.

The Pathology of the Cotton Plant in Nigeria. By G. H. Jones. *Emp. Cotton Grow. Rev.* (1927, **4**, 36–45).

Preliminary Note on an Internal Boll Disease of Cotton in Burma. By D. Rhind. *Agric. Journ., India* (1927, **22**, 34–38).

Weather Damage to Cotton. By R. L. Nixon. *Dept. Bull. No.* 1438, *U.S. Dept. Agric.* Pp. 14, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 5 cents.

A Hybrid between Asiatic and American Cotton Plants, *Gossypium herbaceum*, Linn., and *Gossypium hirsutum*, Linn. By G. S. Zaitzev. Translated from *Trans. Turkestan Plant Breeding Station, Tashkent*, by A. E. Vossnessenski and edited by Trevor Trought. *Agric. Journ., India* (1926, **21**, 460–470).

Study of Off-Type Plants of Acala Cotton. By R. D Martin. *Dept. Circ.* 390, *U.S. Dept. Agric.* Pp. 10, 9 × 6. (Washington: Government Printing Office, 1926.) Price 10 cents.

Correlations of Seed, Fiber and Boll Characters in Cotton. By T. H. Kearney. *Journ. Agric. Res.* (1926, **33**, 781–796).

Méthode d'Appréciation des Diverses Qualités technologiques des Fibres d'un Coton. By F. Heim de Balsac and O. Rœhrich. *Coton et Culture Cotonnière, Travaux de la Section des Cotons* (1926, **1**, 1–29).

Paper-making Materials

Utilisation de la Paille et de la Balle de Riz en Papeterie. By Heim de Balsac and A. Deforge. *Riz et Riziculture* (1926, **2**, 105–130).

Rubber

Rubber Production in Africa. By H. N. Whitford and A. Anthony. *Tr. Prom. Ser. No.* 34, *U.S. Bur. For. and Dom. Comm., Crude Rubber Survey.* Pp. 136, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 25 cents.

Products of the Dutch East Indies. Estate Rubber. Pp. 8, 9 × 5¾. (Buitenzorg: Division of Commerce, Department of Agriculture, Industry and Commerce, 1926.)

Products of the Dutch East Indies. Native-grown Rubber. Pp. 9, 9 × 5¾. (Buitenzorg: Division of Commerce, Department of Agriculture, Industry and Commerce, 1926.)

Catalogue des produits de l'Indochine. Classe XXI, Caoutchoucs, Gutta-percha et Coagulums divers. By C. Crevost. *Bull. Écon. Indochine* (1926, **29**, No. 180, pp. 507–532).

Caoutchoucs d'Hevea. Valeur technologique comparative de divers types. By F. Heim de Balsac, C. Chéneveau and A. Parveaud. *Bull. Ag. Gén. des Colonies* (1926, **19**, 1198–1204).

Manuring of Rubber Estates. By B. J. Eaton and F. G. Spring. *Malayan Agric. Journ.* (1926, **14**, 365–370).

Proeftappingen bij Hevea Zaailingen en Oculaties op de Onderneming Tjinta Radja. Experimental Tapping on Hevea Seedlings and Buddings on Tjinta Radja Estate. By C. Heusser. *Med. Algem. Proefsta., A.V.R.O.S., Rubberserie No.* 54. Pp. 11, 10½ × 7¼. (Buitenzorg: Archipel-Drukkerij, 1926.)

Budding and Seed Selection of High Yielding Varieties of Hevea. By C. E. A. Dias and H. W. Roy Bertrand. *Trop. Agric., Ceylon* (1926, **67**, 259–264).

Further Results of Yields of Rubber from Bud-grafted Trees on Kajang Estate, Sungei Reko Division. By F. G. Spring. *Malayan Agric. Journ.* (1926, **14**, 351–357).

The Inter-relationship of Yield and the various Vegetative Characters in Hevea brasiliensis. By R. A. Taylor. *Bull. No.* 43, *Rubber Res. Scheme, Ceylon* (*Bull. No.* 77, *Dept. Agric., Ceylon*). Pp. 65, 8½ × 5½. (Colombo: Government Printer, 1926.)

A Pathological Survey of the Para Rubber Tree (*Hevea brasiliensis*) in the Amazon Valley. By J. R. Weir. *Dept. Bull. No.* 1380, *U.S. Dept. Agric.* Pp. 129 + 33 plates, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 50 cents.

Inoculation Experiments in Relation to "Sun-Scorch" on Exposed Lateral Roots of *Hevea brasiliensis.* By F. S. Ward. *Malayan Agric. Journ.* (1926, **14**, 286–289).

The Preparation of a Standard Plantation Rubber. By F. B. Jones. *Institution of the Rubber Industry, Transactions* (1926, **2**, 180–193; discussion, pp. 193–200).

The Construction of Smoke-houses for Small Rubber Estates. By T. E. H. O'Brien. *Bull. No.* 44, *Rubber Res. Scheme, Ceylon* (*Bull. No.* 79, *Dept. Agric., Ceylon*) Pp. 7 + 4 plates of plans, 8½ × 5½. (Colombo: Government Printer, 1926.)

On the Smoking of Sheet Rubber in Relation to Mould Prevention. By T. E. H. O'Brien. *Bull. No.* 42, *Rubber Res. Scheme, Ceylon.* Pp. 36, 8½ × 5½. (Colombo: Government Printer, 1926)

De Economie van Natriumsilicofluoride als Coagulant. By N. H. van Harpen. *Med. Algem. Proefsta, A.V.R.O.S., Rubberser. No.* 53. Pp. 28, 10½ × 7¼. (Buitenzorg: Archipel-Drukkerij, 1926.)

Valeur industrielle d'un Caoutchouc de Funtumia du Cameroun. By F. Heim de Balsac, C. Chéneveau and A. Parveaud. *Bull. Ag. Gén. des Colonies* (1926, **19**, 1265–1273).

Products of the Dutch East Indies. Gutta Percha. Pp. 11, 9 × 5¾. (Buitenzorg: Division of Commerce, Department of Agriculture, Industry and Commerce, 1926.)

Jelutong. By B. J. Eaton, C. D. V. Georgi and Gunn Lay Teik. *Malayan Agric. Journ.* (1926, **14**, 275–285).

Tobacco

The Treatment of Patches of Inferior Tobacco in North Gujarat. By H. H. Mann, M. L. Patel and V. M. Majmudar. *Bull. No.* 129 *of* 1926, *Dept. Agric., Bombay.* Pp. 13, 9¾ × 6¼. (Bombay: Superintendent of Government Printing, 1926) Price As.1–6 (2*d*.).

The Improvement of Tobacco in Northern Gujarat. By H. H. Mann, M. L. Patel and V. M. Majmudar. *Bull. No.* 132 *of* 1926, *Dept. Agric., Bombay.* Pp. 22, 9¾ × 6¼. (Bombay: Superintendent of Government Printing, 1926.) Price As.4 (5*d*.).

Tobacco Culture. Report on Experiments at the Tobacco Experi-

ment Station, Salisbury, Seasons 1924–25 and 1925–26. *Rhod. Agric. Journ.* (1927, **24**, 51–58).

The Culture of Virginia Tobacco in Southern Rhodesia. Field Management. By D. D. Brown. *Rhodesia Agric. Journ.* (1926, **23**, 972–987).

Report of Officer in Charge, Tobacco Division, Dominion Experimental Farms, Department of Agriculture, Canada, for the Year 1925. Pp. 40, 9¾ × 6½. (Ottawa: Government Printer, 1926.)

The Tobacco Industry of Victoria. By T. A. J. Smith. *Journ. Agric., Victoria* (1926, **24**, 633–637).

Rapport au Gouverneur général sur la culture du tabac en Indochine. By M. Lagleyze. *Bull. Écon. Indochine, Renseignements* (Oct. 1926, pp. 533–540).

Soils for Bright Virginia Tobacco. By A. W. Facer. *Rhodesia Agric. Journ.* (1926, **23**, 1123–1124).

Tobacco Seed Beds. By G. C. Watson. *Rhodesia Agric. Journ.* (1926, **23**, 1022–1026).

Notes on the Planting out of Tobacco. By C. A. Kelsey Harvey. *Rhodesia Agric. Journ.* (1926, **23**, 1014–1016).

Over het vervangen van Dessa-mest door snijdsel van *Crotalaria anagyroides.* By P. M. Bartels. *Med. No.* 55, *Proefsta. voor Vorstenlandsche Tabak.* Pp. 27, 10¼ × 7¾.

Dark Fire-Cured Tobacco. By E. M. Matthews. *Rhodesia Agric. Journ.* (1926, **23**, 1076–1092).

Fire-curing Tobacco Barn. By the Tobacco Advisers, Department of Agriculture. *Rhodesia Agric. Journ.* (1926, **23**, 1092–1095, with working drawings).

Tobacco Cutworms and their Control. By S. E. Crumb. *Farmers' Bull. No.* 1494, *U.S. Dept. Agric.* Pp. 13, 9 × 6. (Washington: Government Printing Office, 1926.) Price 5 cents.

On the Nature of Bacterial Diseases of Tobacco. By J. C. F. Hopkins. *Rhodesia Agric. Journ.* (1927, **24**, 129–134).

Diseases of Virginia Tobacco in South Africa. By F S. Moore. *Reprint No.* 64, *Dept. Agric., Un. S. Afr.* Pp. 30, 9 × 6. (Pretoria: Government Printing Office, 1926.) Price 3*d.*

Drugs

Histological Study of the Bark of *Alstonia scholaris,* R. Brown, from the Philippines. By J. K. Santos. *Philippine Journ. Sci.* (1926, **31**, 415–425).

Note sur l'Aréquier en Indochine. D'après des notes réunies par MM. Pételot, L. Frontou et P. Carton. *Bull. Écon. Indochine* (1926, **29**, No. 179, pp. 321–356).

Note sur le maladie des aréquiers du Ha-Tinh. By J. Bathellier. *Bull. Écon. Indochine* (1926, **29**, No. 178, pp. 159–165).

Les moyens de lutte préconisés contre la maladie des aréquiers. By M. Frontou, *loc. cit.* (1926, **29**, No. 182, pp. 691–693).

Contribution à l'Étude de la Noix de Cola. Les Colatiers au Congo Belge. By L. L'Heureux and J. Pieraerts. *Mm. des Col., Inst. Nat. d'Agron. Col., Nouv. Sér. No.* 84. Pp. 26, 9½ × 6. (Paris: Émile Larose, 1926.) (Extract from *Agron. Col.*, 1926, Nos. 99, 102.)

The Cultivation of Papaya and the Preparation of Papain. By F. A. Stockdale. *Trop. Agric., Ceylon* (1927, **68**, 3–8).

Introduction des Quinquinas au Congo Belge. By R. Kinds. *Bull. Agric., Congo Belge* (1926, **17**, 1–29).

Dyestuffs

The Cultivation of Saffron and its Importance in Spain. By Ricardo de Escauriaza. *Spice Mill* (1926, **49**, 2092–2095).

Miscellaneous Agricultural Products

Report on the Fermentation Industries for 1926. Prepared for the Society of Chemical Industry and the Institute of Brewing. By H. Lloyd Hind. Pp. 37, 9½ × 7¼.

The Nipah Palm, Further Investigations on Tapping and Preservation of the Juice. By J. H. Dennett. *Malayan Agric. Journ.* (1926, **14**, 375–383).

FORESTRY

General

Administration Report of the Conservator of Forests, Ceylon, for 1925. Pp. 18, 13 × 8¼. (Colombo: Government Printer, 1926.) Price 40 cents.

Progress Report of the Imperial Forest College, Dehra Dun, for the Year 1925–26. Pp. 29, 9¾ × 6½. (Calcutta: Government of India Central Publication Branch, 1926.) Price Rs.2 As.14 (5*s.* 3*d.*).

Progress Report of Forest Administration in the Province of Assam for the Year 1925–26. Pp. 53, 13 × 8¼. (Shillong: Government Press, 1926.) Price R.1 or 2*s.*

Report on the Forest Administration of the Central Provinces for the Year 1925–1926. Pp. 50, 9¾ × 6½. (Nagpur. Government Press, 1926.)

Annual Progress Report of Forest Administration in the United Provinces for the Period April 1, 1925, to March 31, 1926. Pp. 25 + cviii + 4, 9¾ × 6½. (Allahabad: Government Press, 1926.) Price Rs.7 As.8.

Annual Report on the Forestry Department, North Borneo, for 1925. *Supplement to the Official Gazette*, Dec. 1, 1926, pp. 67–75.

Forestry in Southern Rhodesia. The Raising of Plants from Cuttings. By A. S. Thornewill. *Rhod. Agric. Journ.* (1927, **24**, 12–19).

Report of the Forestry Commission, New South Wales, for the Year ended June 30, 1926. Pp. 19, 13 × 8¼.

Report of the Provisional Forestry Board, Queensland Forest Service, for the Year ended June 30, 1926. Pp. 131, 13 × 8¼. (Brisbane: Government Printer, 1926.)

Report of the Forests Department, Western Australia, for the Year ended June 30, 1926. Pp. 50, 13 × 8¼. (Perth: Government Printer, 1926.)

Rapport sur la Forêt de Bukaka-Kabote (Kasai). By M. Demeuse. *Bull. Agric., Congo Belge* (1926, **17**, 55–131).

Trees for Roadside Planting. By F. Ll. Mulford. *Farmers' Bull.* 1482, *U.S. Dept. Agric.* Pp. 50, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 10 cents.

Grazing Periods and Forage Production on the National Forests. By A. W. Sampson and H. E. Malmstein. Pp. 54, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 15 cents.

Red Alder of the Pacific Northwest. Its Utilization, with Notes on Growth and Management. By H. M. Johnson, E. J. Hanzlik and W. H. Gibbons. *Dept. Bull. No.* 1437, *U.S. Dept. Agric.* Pp. 43, 9¼ × 6. (Washington: Government Printing Office, 1926.) Price 10 cents.

The Felted Beech Coccus (*Cryptococcus fagi*, Barensp.). *Leaflet No.* 15, *Forestry Commission.* Pp. 4, 9¾ × 6¼. (London: Forestry Commission, 1926.) Gratis.

Biology and Control of the White-Pine Weevil, *Pissodes strobi*, Peck. By S. A. Graham. *Bull.* 449, *Cornell Univ. Agric. Exper. Sta.* Pp. 32, 9 × 6. (Ithaca, New York: Experiment Station, 1926.)

Acacia Gall-Fungus. By G. H. Cunningham. *New Zealand Journ. Agric.* (1926, **33**, 92–97).

Timbers

Products of the Dutch East Indies. Timber. Pp. 8, 9 × 5¾. (Buitenzorg: Division of Commerce, Department of Agriculture, Industry and Commerce, 1926.)

Der westafrikanische Urwald und die deutsche Holzwirtschaft. By A. Korn. *Tropenpflanzer* (1926, **29**, 395–406).

Tropical Hardwoods with Special Reference to their Uses in American Industries. By G. P. Ahern. *Bull. Pan-American Union* (1927, **61**, 219–227).

Notes illustrées sur les Bois de Nouvelle-Calédonie et sur les Arbres qui les fournissent. By K. Mezger. *Ann. Mus. Col., Marseille* (33e année, 4e sér., 4e vol., 1926, 2nd fasc., pp. 1–29, with 81 plates).

The Identification of Furniture Woods. By A. Koehler. *Misc. Circ. No.* 66, *U.S. Dept. Agric.* Pp. 78, 9 × 6, with 30 plates. (Washington: Government Printing Office, 1926.)

Air Seasoning Study. First Report on the Air Seasoning of one-inch Jarrah Flooring. By S. A. Clarke and T. J. Rankine-Wilson. *Bull.* 38, *For. Dept., W. Australia.* Pp. 10, 9½ × 6¼. (Perth: Government Printer, 1926.)

Relation of Rate of Growth to Strength in Timber. By L. N. Seaman. *Ind. Forester* (1926, **52**, 619–625).

Tanning Materials

Écorces tannifères de la Mangrove de Madagascar. By F. Heim de Balsac and J. Maheu. *Bull. Ag. Gén. des Colonies* (1926, **19**, 1205–1213; 1274–1280).

Resins

Le *Liquidambar orientalis* producteur du Styrax liquide. By J. Carle and J. Simons. *Agron. Col.* (1926, **15**, No. 107, 165–170).

NOTICES OF RECENT LITERATURE

Year Book of Agricultural Co-operation in the British Empire (with a Census of Producers' Organisations). Edited by The Horace Plunkett Foundation. Pp. viii + 254, 8½ × 6. (London: George Routledge & Sons, Ltd., 1927.) Price 10*s*. 6*d*.

This is a work which should be of much interest to students of rural economy in general as well as to readers more especially concerned with agricultural marketing problems in British countries. About half the volume is occupied by excellent descriptive articles on agricultural co-operation in the Dominions, India, Ireland and Scotland, with a chapter on agricultural societies in Palestine. Following this is a useful bibliography of agricultural co-operation. The second half of the book is statistical, and is described in its title, viz. Census of Agricultural Co-operative Organisations in the British Empire.

The Commerce of Agriculture. A Survey of Agricultural Resources. By Frederick A. Buechel, Ph.D. Pp. ix + 439, 9 × 6. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1926.) Price 18*s*. 6*d*.

This work, by the Professor of Agricultural Economics in the Agricultural and Mechanical College of Texas, is naturally written from an American standpoint, and is intended more especially for college students; but all

readers interested in agricultural economics will find it a useful and comprehensive treatise, which, to use the author's own words, "presents the agricultural industry in world perspective" and "points out to the student in a broad way the great technological and economic problems of agriculture."

THE PRODUCTION OF COTTON. By Gilbeart H. Collings, B.S., M.S., Ph.D. Pp. xi + 256, 9 × 6. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1926.) Price 17*s*. 6*d*.

This work forms a useful text-book on cotton cultivation in the United States. It deals with climate, soil, cultivation, manuring, harvesting, ginning and baling, warehousing, marketing and transport, and with the diseases and pests by which the cotton plant is liable to be attacked. Other parts of the book relate to the grading of cotton, the by-product of the industry, the feeding value of cotton seed and husks, and the toxic properties of cotton seed and cotton seed meal. The numerous varieties of American cotton are classified and information is given on the methods of improving cotton by selection and breeding. Chapters are also devoted to the history of cotton production in the United States and the cultivation of American-Egyptian cotton in Arizona and California.

In view of the new conditions which have arisen owing to the spread of the boll weevil, the author has described the practices followed under non-weevil conditions and has added information, based on the experimental evidence so far available, regarding the best methods to adopt when boll weevil is present.

Reference may be made to a chapter of two pages on the cotton regions of the world which contains short paragraphs on the United States, India, China, Egypt, Brazil and Russia. The information supplied is not merely very brief but to some extent misleading. For example, it is said that "the fibre produced [in India] is similar to that grown in China," a statement which requires some qualification. Again, it is stated that "the Ashmuni variety formed the bulk of the Egyptian crop for many years, but it is now entirely superseded by the Mit Afifi."

On the whole, the work is well written and illustrated and should be of service both to the agricultural student in the United States and to the American cotton farmer. A valuable feature is the inclusion of a list of publications, especially those of the United States Department of Agriculture, at the end of each chapter.

THE ARTIFICIAL SILK HANDBOOK. Compiled and Edited by Frank Nasmith, F.T.I. Pp. 135, $7\frac{1}{4} \times 4\frac{3}{4}$. (Manchester and London: John Heywood, Ltd.) Price 3*s.* 6*d.*

This small book will be of value to all engaged or interested in the manufacture and utilisation of artificial silk. By the use of small type and economy of words, a large amount of information has been brought together bearing upon all important aspects of the industry. The history of artificial silk is followed by an account of the raw materials used in its manufacture and a description of the several commercial processes by which it is produced. " Staple " fibre and " tubular " silk are dealt with and the important use of the artificial fibre in combination with the standard textile fibres is briefly discussed. There is an account of the processes employed in the manufacture of artificial silk fabrics, and tables are given of counts and equivalents for comparison with sizes employed in the older branches of the textile industry. A useful section gives the names of makers of artificial silk machinery of all kinds. If means can be found to revise and develop this book from time to time in order to present a résumé of the current technical and commercial position of the artificial silk industry, a very useful purpose will be served.

A TREATISE ON VITICULTURE. By A. I. Perold, B.A., Dr.Phil. Pp. xi + 696, $8\frac{3}{4} \times 5\frac{3}{4}$. (London: Macmillan & Co., Ltd., 1927.) Price 25*s.*

There are a number of books on viticulture in French, German and Italian, and the present treatise is an attempt to supply a comprehensive work on the subject in English, primarily for the use of readers in California, Australia and South Africa. It would seem that this object has been well achieved and that the book may be classed at once as a " standard work."

An introductory chapter is devoted to the geographical distribution of the vine and the influences upon it of climate and soil. The next four chapters, which will be of considerable interest to the serious student of botany, occupy half the book and deal in detail with the morphology and biology of the vine, and the factors influencing the usefulness of a stock (for example, in regard to ease of propagation and to power of resistance to phylloxera), and include an account of the classification of the order Ampelidaceæ and the genus *Vitis* as well as an exhaustive study of the numerous varieties of the plant and their characteristics.

There are chapters on the propagation of the vine,

and on the theory of grafting; the latter will well repay the effort that its study may exact from the non-scientific reader. The diseases and pests of the vine, the factors favouring them, and the methods of combating them, are dealt with, as are also the question of manuring, the establishment and maintenance of vineyards, and the important matters of pruning and trellising. The production for export and marketing of table grapes are treated in a useful and comprehensive manner; and a final chapter on "products of the vine" deals with vinegar, grape syrup, unfermented grape juice and raisins. Wine-making is only mentioned in passing, and there are equally brief references to brandy and spirits of wine.

MAIS By Prof. Dr. A. Eichinger. Bangerts Auslandbücherei, No. 32. Reihe: Wohltmann-Bücher, Monographien zur Landwirtschaft warmer Länder, Band 5. Pp. viii + 183, $7\frac{1}{4} \times 5$. (Hamburg: Deutscher Auslandverlag Walter Bangert, 1926.) Price RM.5.

In this small book the author contrives to present a very complete account of maize, from a botanical description of the plant and its varieties to the utilisation of the harvested grain. The history of the subject is briefly sketched in the opening chapter; this is followed by an account of breeding and selection, while the main part of the book deals with cultivation, harvesting, and pests and diseases. Statistics of yields, cost of production, areas under cultivation and outputs in various countries are summarised and a short account is given of the use of maize as a green fodder and as silage.

LES ALEURITES PRODUCTEURS D'HUILES SICCATIVES DITES HUILES DE BOIS. By Prof. Émile Perrot and Mme. Yv. Khouvine, Docteur ès-sciences. Notice No. 2. Travaux de l'Association "Colonies-Sciences." Pp. 50, $9\frac{1}{2} \times 6$. (Paris: Association Colonies-Sciences. 1926.) Price 15 francs.

This pamphlet is written with the object of encouraging the extension in Indo-China of the cultivation and exploitation of *Aleurites montana* (abrasin), one of the two trees which produce the Chinese wood oil of commerce. With this end in view, the authors have collected together the available information on wood oils, especially those coming from China. A botanical description and an account of the geographical distribution are given of the three trees from which wood oil is derived, *A. Fordii* (tung) and *A. montana* yielding the Chinese variety and *A. cordata* that coming from Japan. This is followed by

a brief outline of the methods in vogue in China for the preparation of the oil. Other sections of the pamphlet deal with the chemical characters and composition of the oils, and with their commercial utilisation and trade. An account is also given of the cultivation of *A. Fordii* and *A. montana* in China and Indo-China and of *A. Fordii* in the United States of America.

A DESCRIPTIVE CATALOGUE OF SOME OF THE COMMON TREES AND WOODY PLANTS OF KENYA COLONY. By E. Battiscombe, F.L.S. Pp. 142, 9½ × 7¼. (London: The Crown Agents for the Colonies, 1926.) Price 10*s*.

This book, which is well produced and illustrated with many good photographs, is the first descriptive list of woody plants occurring in Kenya. It does not claim to include all such plants, but aims at providing a short description of the more common trees, shrubs and other woody plants, together with a small number of herbs, occurring in the Colony and likely to be met with by settlers. Nearly 300 plants are catalogued and arranged in natural families grouped in the sequence recently proposed by Hutchinson. Practically all the species have been determined at Kew from herbarium specimens collected by the Forest Department. In each description the botanical and native names are followed by a short account of the general characters of the plant, and of the mode of growth and type of locality in which it is normally found; where feasible, notes on the economic value of the timber or other products yielded by the plant are given. The book should stimulate local interest in the forest flora of Kenya, and may hasten the appearance of a fuller work which will include a "key" for the identification of the species.

FERTILIZERS. THEIR SOURCES, MANUFACTURE, AND USES. By Herbert Cave. Pp. xi + 116, 7¼ × 5. (London: Sir Isaac Pitman & Sons, Ltd.). Price 3*s*. 6*d*.

This little book constitutes an excellent introduction to the subject of fertilisers and deals mainly with their sources and manufacture. It also contains a brief statement regarding the utilisation of fertilisers in agriculture. It is intended particularly for the general and commercial reader and has therefore been written in as non-technical a manner as possible. It is questionable, however, whether this aim justifies a looseness of expression such as occurs on p. 20, where it is stated, for example, that "The insoluble mineral phosphate of lime, from which superphosphate is prepared, is known as 'tricalcium phos-

phate,' that is, three parts of lime (calcium) to one of phosphoric acid." On the whole, however, the book is well written and should prove of much assistance to those desirous of obtaining general information on the subject.

CASEIN: ITS PREPARATION, CHEMISTRY AND TECHNICAL UTILIZATION. By E. L. Tague, Ph.D. Pp. v + 218, 8½ × 5½. (London: Constable & Co., Ltd., 1926.) Price 17*s*.

This book, written by the Associate Professor of Chemistry at the Kansas State Agricultural College, explains the chemistry and industrial uses of casein in the light of present-day practice. It deals with casein itself, with the compounds of casein with alkalis, alkaline earths and heavy metals, and also with the decomposition products of casein. The technical preparation of casein is the subject of the largest chapter, and this is followed by a brief description of the methods of testing the product. The technical uses of casein are discussed and the book concludes with short summaries of various patent specifications, a bibliography and an index.

LABORATORY EXPERIMENTS IN DAIRY CHEMISTRY. By Leroy S. Palmer, Ph.D. Pp. xiii + 84, 9 × 6. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1926.) Price 7*s*. 6*d*.

This work, written as a supplement to a course of lectures in Dairy Chemistry given in the University of Minnesota, is intended primarily as a guide to practical work and consists for the most part of qualitative experiments of a biochemical nature on milk.

A chapter at the end of the volume is devoted to the quantitative examination of milk, including Van Slyke and Bosworth's volumetric estimation of casein, and a cryoscopic method of estimating added water.

The book contains a comprehensive list of literature bearing on the various experiments, and should be of use to students undergoing a course of Dairy Chemistry in agricultural colleges.

ENZYMES: PROPERTIES, DISTRIBUTION, METHODS AND APPLICATIONS. By Selman A. Waksman, M.S., Ph.D., and Wilburt C. Davison, M.A., M.D. Pp. xii + 364, 9½ × 6. (London: Ballière, Tindall & Cox, 1926.) Price 25*s*.

The object of the authors has been to present in as concise a form as possible a review of the extensive literature on the subject of enzymes. In the preface it is stated that over two thousand references have been consulted,

and an endeavour made "to piece these irregular and loosely fitting fragments together into a mosaic upon which future studies may rest." The book is divided into four parts. Part A deals with the properties of enzymes, their classification, chemistry and reactions. Part B describes the distribution of enzymes under three headings, viz. enzymes of the human and animal body, plant enzymes, and those occurring in micro-organisms. Part C, the largest section of the book, is devoted to the methods of preparation of enzymes and the measurement of their activity, and includes a study of individual enzymes, while Part D treats of the practical applications of enzyme action, and the rôle which enzymes play in the textile, tanning and brewing industries, in the preparation of foodstuffs, the fermentation of tobacco and other technical operations. The book concludes with a comprehensive bibliography occupying 77 pages.

Catalysis in Theory and Practice. By Eric K. Rideal and Hugh S. Taylor. Pp. xv + 516, 9 × 6. Second Edition. (London: Macmillan & Co., Ltd., 1926.) Price 20s.

The aim of the authors in writing this book is stated to be "to present a critical survey of the catalytic field from the standpoint of the theory of the subject." The first edition was published in 1919, but the advances which catalysis has made since then are so great as to necessitate the preparation of a second edition. The text of the former edition has been completely revised and brought up to date. Three new chapters have been added on (1) promoters, mixed, supported and protected catalysts; (2) catalyst poisons and the inhibition of homogeneous chemical reactions; and (3) colloidal catalysts; while the chapter on ferments and enzymes has been omitted.

The opening chapter is devoted to an account of the early history of catalysis. This is followed by others dealing mainly with the theoretical aspects of the subject. Subsequent sections are concerned with those catalytic processes which are of industrial importance; the authors have placed these in different groups according to the nature of the process. Under the heading of "processes of oxidation" reference is made, among others, to the chamber process, for the manufacture of sulphuric acid; the oxidation of ammonia to nitric acid; Deacon's and Weldon's methods for the production of chlorine from hydrochloric acid; and to the drying of oils. The chapter entitled "Hydrogenation" describes the manufacture of hydrogen for use in this process; gives an account of the

different catalysts employed; and deals with the production of methane and the hardening of oils. The cracking of oils is considered under the heading of dehydrogenation, while the manufacture of glucose from starch-containing materials and from cellulose, and the saponification of oils and fats by alkali, sulphuric acid and Twitchell's reagent are to be found in the section dealing with those processes in which catalytic hydrolysis is involved. The last four chapters have to do with catalysts in organic chemistry; catalysis in electrochemistry and in analytical chemistry; and catalysis by radiant energy.

This book is one that can be recommended to all those who desire to study the theory underlying the different catalytic processes of technical importance.

Van Nostrand's Chemical Annual. Sixth Issue, 1926. Edited by John C. Olsen, A.M., Ph.D., D.Sc. Pp. xv + 882, 7½ × 5. (London: Chapman & Hall, Ltd., 1927.) Price 21*s*.

This *Annual* was first issued in 1906. In the present edition the work has been thoroughly revised and enlarged, and forms one of the most useful and comprehensive reference books for the laboratory which have been published. The editor and his associates, in selecting information of general interest which has appeared since the last edition, have revised and corrected all tables for which new data have been recorded, and have also introduced a considerable number of fresh tables. These include tables on isotopes, hydrogen ion concentrations and hydrogen values, specific gravity and solubilities, isoelectric points of proteins, and pressure of aqueous vapour of hydrated salt systems, as well as comprehensive tables of the physical properties of lead and mercury. The section enumerating the more important books has been revised, and is now confined to those published since 1921.

The Support of Underground Workings in the East Midland Coalfield (Yorkshire, Derbyshire excluding South Derbyshire, and Nottinghamshire). Safety in Mines Research Board Paper No. 30. Pp. 48, 6 × 9¾. (London: H.M. Stationery Office, 1927.) Price 2*d*. net (4*d*. including postage) or 6*s*. 3*d*. for 50 copies (9*s*. 3*d*. including postage).

This is the third report of the Committee appointed to investigate methods of reducing the number of accidents due to falls of ground in coal mines. The Committee are making a study of timbering practice in certain coal-

fields and have dealt with South Wales and Scotland in earlier reports (Safety in Mines Research Board Papers Nos. 6 and 12).

In the present report the Committee give descriptions (including many sketches) of the usual methods of supporting the workings in the East Midland Coalfield, and draw attention to points that may be commended or criticised. All aspects of the problem of supporting the workings and preventing accidents from falls of ground are discussed, and many suggestions are made for the improvement of practices at present followed at some of the mines.

The report will be found of value to those concerned with mine timbering in other districts besides the East Midland Coalfield.

HANDBOOK OF CORNISH GEOLOGY. By E. H. Davison, B.Sc., F.G.S. Pp. 103, $8\frac{1}{2} \times 5\frac{1}{2}$. (Penzance: Royal Geological Society of Cornwall; London: Edward Stanford, Ltd., 1926.)

This handbook gives a brief but useful illustrated account of the geology of Cornwall. There is an introductory section on the geography of the county, followed by an outline of its geology. Chapter 2 deals with the metamorphic rocks of the Lizard. Chapters 3 to 8 (pp. 24–64) deal with the Palæozoic strata and the various igneous rocks. A chapter of thirteen pages (chapter 9) is given to an account of the lodes of Cornwall. The Mesozoic and Tertiary rocks of the county are given four pages in chapter 10, and a concluding chapter gives an account of the Pleistocene and later deposits. There are two useful appendices, one mentioning localities of geological interest, and the features to be observed there, the other giving a bibliography of works on Cornish Geology published since 1906. A geological sketch map is included, showing the situation of Cornish mines.

As a brief and up-to-date account of the geology of Cornwall by one well qualified to write on this subject, the book will be welcomed by those many visitors to the county who take an interest in mining and geology; but it would be improved by the elimination of the rather frequent misprints that mar its pages.

BUILDING STONES: THEIR PROPERTIES, DECAY, AND PRESERVATION. By Arthur R. Warnes, A.Inst.P., F.I.C., M.I.Chem.E., A.I.Struct.E. Pp. 269, $8\frac{3}{4} \times 5\frac{3}{4}$. (London: Ernest Benn, Limited, 1926.) Price 16*s*.

It is remarkable that building stones should have received such scant attention by technical writers. The

few books that have appeared are mostly by geologists. The present book, however, is from the pen of an architect who has endeavoured to present a good descriptive account of the stones used for building in this country, principally for the assistance of those engaged in the building industry.

The work is divided into two approximately equal parts, the first part consisting of descriptive accounts of the properties of the principal stones used, while the second part deals with the causes and effects of decay in buildings and with the various methods employed to combat the destructive agencies. In the first part there is not much that is new, since it is largely a compilation from previous descriptive works; but the descriptions given are adequate and clear, and the text is supplemented with many excellent photographic and photomicrographic illustrations.

A useful feature is the inclusion, where possible, of the approximate prices of the stones fixed complete, including scaffolding, for the London district. The author has also added remarks as to the suitability of the stones for different classes of work and their behaviour when exposed to polluted atmospheres. One notices, however, an unfortunate lack of references both to the works of other writers and to particular buildings in which the stones mentioned have been employed.

In the second part of the book there is much which the author has learnt from practical experience in the utilisation of building stones, and this is valuable. The chapters on the cleaning, preserving and restoring of stone in buildings are of particular interest and full of practical information. The author considers that the most suitable material for consolidating decaying stone is silica, the only successful method of depositing which in the pores of the stone is by the use of silicon ester, applied by skilful workers.

POTASH: A REVIEW, ESTIMATE AND FORECAST. By J. W. Turrentine, Ph.D. Pp. ix + 188, 9 × 6. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1926.) Price 15*s*.

The author is in charge of potash investigations at the Bureau of Soils, U.S. Department of Agriculture, and is, therefore, in a good position to deal with this subject. He gives a good account of the potash supplies in the United States as well as an adequate review of the general world position. He believes that the potash now thrown away by existing American industries is more than sufficient for domestic requirements, and can be recovered on an economic basis.

The motif running through this book is the fear that the United States should be dependent for supplies on foreign countries and, consequently, at the mercy of foreign producers. This anxiety about future supplies of raw materials seems to have become very prevalent in the United States in recent years. War experience showed that potash supplies could be cut off entirely, but at the same time it proved the availability of domestic supplies. By 1918, the domestic production amounted to 54,803 short tons of available K_2O, and new plants were ready to come into operation that brought the producing capacity of the country up to 100,000 tons of K_2O. On the reappearance of German supplies on the American market, the domestic potash industries for the most part collapsed; but a few plants remained in operation, and the output in 1925 was returned as equivalent to 25,439 short tons of K_2O.

The book opens with a statement of the pre-war position of the potash market, followed by short statements reviewing each foreign potash industry in turn and the present economic situation. This section occupies 45 pages in all. The rest of the book deals with the American potash industry and is most informative and full of illuminating suggestions. Each possible domestic source of potash is dealt with, i.e. kelp, surface-brines, continental deposits (salt lakes, etc.), silicates and other minerals, industrial wastes and the Texas deposits of po' 'sh salts. Under industrial wastes are included that from the beet-sugar refineries known as Steffens waste, liquors from alcohol manufacture, blast-furnace dust and cement dust.

In each case, the supplies available are stated as well as the additional supplies that the author would expect to become available by improved technique. The present position of the various processes are reviewed and stimulating suggestions given for further development of them. In connection with the Texas deposits the opinion is expressed that the systematic drilling required to prove their extent must be carried out at Government expense. Even supposing that valuable deposits are proved, the author does not appear to think that potash from this source would be able to compete in eastern markets with the imported salts.

The book is furnished with a good index, is well printed and singularly free from misprints. It can be strongly commended to all those interested in the subject.

THE SCIENTIFIC PRINCIPLES OF PETROLEUM TECHNOLOGY. By Dr. Leo Gurwitsch, translated and revised

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The book is furnished with a good index, is well printed and singularly free from misprints. It can be strongly commended to all those interested in the subject.

The Scientific Principles of Petroleum Technology. By Dr. Leo Gurwitsch, translated and revised

by Harold Moore, M.Sc.Tech., M.I.Petrol.Tech., F.C.S., A.I.Mech.E. Pp. xvi + 470, 8½ × 5½. (London: Chapman & Hall, Ltd., 1926.) Price 25s. net.

The author, who is professor of the University and the Technical High School at Baku, has produced a very readable and interesting review of the petroleum industry from the chemist's and physicist's points of view. All consideration of plant detail is omitted and only the theoretical aspect of the subject is treated. The original German edition was completed in 1912. The present translation is of the second edition revised in 1924, but the translator has found it necessary to make further alterations and additions, particularly in the sections dealing with cracking and with detonation in internal combustion engines. The work is divided into three main parts, Raw Material, Manufacture and Products.

Under Raw Material, the constituents of petroleum and their chemical behaviour are discussed, then the physical properties—optical, electrical, thermal, etc.—followed by brief particulars of the most important oilfields and characteristics of the oil produced in each. An appendix to this section dealing with the vexed question of the origin of petroleum is an excellent summary of the present state of the controversy.

The section on Manufacture opens with a short consideration of methods in use for removing water from oil before distillation, the latter operation in its various modifications being then fully discussed, as well as the subject of cracking, which is alternatively described as pyrogenetic decomposition or pyrolysis. In this connection, the author states that " although enormous sums have been spent on the development of cracking processes, practically all the work done has been confined to physical experiments and to researches connected with the engineering side of the manufacturing plant. The chemistry of the process is not much more fully understood to-day than it was several years ago, although the technical development of the plant has made enormous strides."

Refining is treated in some considerable detail, both in regard to the action of sulphuric acid on the various hydrocarbons and other compounds occurring in petroleum, and the influence it exerts according to various factors enumerated such as quantity, strength, temperature, etc., of the acid employed. The description of the subsequent treatment with alkali involves an interesting inquiry into the formation of emulsions and phenomena connected with them. Included under the subject of refining is a consideration of its influence on the physical

properties of the product and the loss involved in the operation. Refining by absorption is dealt with in an interesting manner.

The final section deals with the products obtained, viz. benzine, illuminating oils, lubricating oils, paraffin wax and vaselines.

The author gives many examples from his experience with Balachany oil that would have been more useful if accompanied by comparisons with other oils. The use of the word " weathering " for evaporation might have been avoided with advantage as well as that of " resin content " for asphalt. The sub-section dealing with characteristics of the most important crude oils is so condensed as to be of little value and might well have been omitted. There is no reference to Colombia, although production there has now brought that country into the ranks of the most important producers.

The book is well printed and carefully edited, and will fill a useful place in the literature of the subject. An adequate index is provided. The translation has been well done and the part revised by the translator, dealing with detonation in internal combustion engines, is of particular interest.

GALVANIZING. A THEORETICAL AND PRACTICAL TREATISE ON THE SUBJECT FOR THE USE OF WORKS MANAGERS, STUDENTS AND OTHERS. By Heinz Bablik, translated by Chas. T. C. Salter. Pp. 168, 9 × 6. (London : E. & F. N. Spon, Ltd., 1926.) Price 12*s.* 6*d.*

In his preface to this book, the author states that " theory is the best guide to practice," which is, of course, the modern conception of the function of science in industry. He treats each step in the process of galvanising on the principle of theory first and practice afterwards, illustrating his arguments by experimental data from his own experience. In fact, he states that the book is almost exclusively a record of his own work.

In addition to the ordinary process of hot-galvanising the author deals with electro-galvanising, sherardising, and zinc-coating by the Schoop process or spray-galvanising. Chapter I discusses rust and its prevention, and is followed by a discussion of the structure of zinc-coatings obtained by the four methods above mentioned. Pickling, the flux, and hot-galvanising are the subjects of separate chapters, as well as the important question of raw materials and waste products of the process. The other methods of galvanising are then described, and the final chapter is on testing and judging galvanised coatings. A

good index completes the book, which is well printed and illustrated and free from misprints. It should also be mentioned that the translation has been well done. Everyone interested in galvanising will welcome this book, and the publishers are to be congratulated upon adding it to the useful series they have already published.

METHODEN DER ANGEWANDTEN GEOPHYSIK. By Dr. Richard Ambronn. Pp. xii + 258, 8½ × 6. (Dresden-Blasewitz: Theodor Steinkopff, 1926.) Price RM.15.

Physical methods for the investigation of the earth's crust have developed apace in recent years, and there is now an extensive literature dealing with this subject, which covers a wide range of physics and bears on some of the more profound scientific problems of geology as well as on many practical resources problems. Geodetic observations, magnetic and electrical variations in relation to the structure and composition of the earth's crust, measurements of radioactivity, the propagation of earthquake waves and other tremors and the way in which they are affected by the crust masses they traverse, temperature gradients in the earth's crust and the thermal conductivities of rocks: these and other branches of geophysics have all been actively investigated in recent years, and it is useful to have laid out for one, as the author does in this book, a brief and concise record of the literature thus accumulated and a summary account of the numerous methods described.

In addition to an ordinary index, the book includes a bibliographical index of a very useful kind, and the author is to be congratulated on the skill with which he has compressed so much excellent matter into so small a volume.

COMMERCIAL AIR TRANSPORT. By Lieut.-Col. Ivo Edwards, C.M.G., and F. Tymms, M.C., with a Foreword by Air Vice-Marshal Sir Sefton Brancker, K.C.B., A.F.C. Pp. xv + 163, 8½ × 5½. (London: Sir Isaac Pitman & Sons, Ltd., 1926.) Price 7*s.* 6*d.*

The great extension of aerial transport in recent years and its future possibilities lend special interest to this informative book, which in the opinion of Sir Sefton Brancker may be looked upon as "a milestone in the general progress of commercial aviation in the British Empire." The writers have not aimed at a detailed technical treatise, and do not deal at any length with airships, but they offer a presentation of the basic principles of commercial transport by aeroplane and have admirably succeeded in their task.

REPORTS OF RECENT INVESTIGATIONS AT THE IMPERIAL INSTITUTE

Selected from the reports made to the Dominion, Colonial and Indian Governments

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INVESTIGATIONS OF ESSENTIAL OILS

In the following pages an account is given of the results of examination of essential oils and materials yielding such products which have been received recently at the Imperial Institute from various countries of the Empire.

1. Pelargonium Oil from South Africa

A sample of pelargonium oil was received from the Director, National Botanic Gardens, Kirstenbosch, in January, 1927. It was stated that the oil had been distilled from the fresh green shoots of a variety of pelargonium cultivated in private gardens. The identity of the plant is unknown, but it is probably a hybrid in which one of the parents is *P. graveolens*. It was mentioned that the yield of oil obtained was approximately 0·04 per cent. of the weight of the fresh herb.

It was desired that the commercial value of the oil should be determined in order to ascertain whether it would be worth while to cultivate the plants on a larger scale for the production of the oil.

The sample consisted of a clear, pale yellowish-brown oil with a greenish tint and a characteristic pleasant rose-like odour. It was submitted to examination and the results are given below in comparison with the corresponding constants recorded by Parry (*The Chemistry of Essential Oils*) for the Algerian and Bourbon geranium (pelargonium) oils of commerce :

—	Present sample.	Commercial geranium oils.	
		Algerian.	Bourbon.
Specific gravity at 15/15° C.	0·901	0·892 to 0·904	0·888 to 0·896
Optical rotation α_D . .	−8·1°	−6·5° to − 12°	−7·8° to −13·8°
Refractive index $n_D 20°$ C. .	1·466	1·465 to 1·472	1·462 to 1·468
Acid value . . .	0·8	1·5 to 9·5	1·5 to 12
Ester value . . .	2·0	34 to 70	50 to 78
Esters (expressed as geranyl tiglate) . *per cent.*	0·8	14·3 to 29·5	21 to 33
Ester value after acetylation	222·8	203 to 230	206 to 233
Total alcohols (expressed as geraniol) *per cent.*	73·6	62 to 71·5	60 to 71
Solubility in 70 per cent. alcohol at 15° C. . .	Clear solution not obtained.	Soluble in 2 to 3 vols.	Soluble in 2 to 3 vols.

These results show that the present sample of oil contains a good percentage of alcohols, but differs from commercial geranium oils in containing only a very small quantity of esters. With regard to the solubility of the oil it is probable that the failure to obtain a clear solution in 70 per cent. alcohol is due to the separation of a stearoptene.

The sample was submitted to a firm of essential oil merchants who confirmed the result obtained at the Imperial Institute that the ester value of the oil is abnormally low. They stated, however, that they would be willing to purchase such oil for manufacturing purposes at a price of about 8*s.* to 8*s.* 6*d.* per lb. The current price of Bourbon and Algerian geranium oils in London was 11*s.* to 11*s.* 6*d.* per lb. (April, 1927).

The firm added that if a further small quantity of the oil were available they would be glad to receive it for technical trial with a view to determining its possibilities in comparison with those of the geranium oils now being imported.

A firm of soap manufacturers who were consulted also reported that, on the basis of the odour, the oil should command a price of approximately 80 per cent. of that of the Bourbon oil or about 8*s.* to 8*s.* 6*d.* per lb. in this country at that time. They added that the odour on drying is nearer to that of Algerian geranium oil, but is rather less powerful when fresh, and that it would probably be a little weak if used for perfuming soap.

This sample of pelargonium oil from South Africa possessed a good fragrance, and there is little doubt that commercial supplies of similar character would be saleable in this country.

It may be mentioned that the yield of oil obtained from the plants, namely 0·04 per cent. from the fresh material, appears to be somewhat low, the normal yield from the species of pelargonium yielding the commercial geranium oils being given as from 0·1 to 0·2 per cent. If, however, the oil could be produced remuneratively at 8*s*. per lb. (delivered in the United Kingdom), the cultivation of the plant and distillation of the oil might well be encouraged.

2. Rosemary Oil from South Africa

A sample of oil which had been distilled from the fresh branches of *Rosmarinus officinalis* grown at the National Botanic Gardens, Kirstenbosch, was received in January, 1927. It was stated that the yield obtained was 0·52 per cent. of the weight of the fresh material.

It was desired that the commercial value of the oil should be determined in order to ascertain whether it would be worth while to cultivate the plants on a larger scale for the production of the oil.

The sample consisted of a clear, almost colourless oil with the characteristic camphoraceous odour of rosemary. The odour differed from that of the commercial oils of rosemary in being more terpene-like and less camphoraceous.

The results of examination of the oil are given on p. 110, in comparison with the constants recorded by Parry (*The Chemistry of Essential Oils*) for the principal commercial varieties and with the requirements of the British Pharmacopœia for rosemary oil.

The constants of the present sample are on the whole in fair agreement with those recorded for the chief rosemary oils of commerce, but the percentage of total alcohols (calculated as borneol) is low, and in this respect the oil fails to comply with the requirements of the British Pharmacopœia. The percentage of esters is also rather low, and the oil is less soluble in alcohol than is generally the case.

—	Present sample.	Commercial rosemary oil.			British Pharmacopoeia requirements for rosemary oil.
		French.	Dalmatian.	Spanish.	
Specific gravity at 15/15° C.	0·900	0·900 to 0·920	0·894 to 0·914	0·898 to 0·922	0·895 to 0·920
Optical rotation α_D	+ 5·0 (at 25° C.)	− 4° to + 13° (rarely to − 9°)	− 1° to + 7° (rarely to + 12°)	− 6° to + 12°	− 2° to + 15°
Refractive index $n_D 20°$ C.	1·469	1·466 to 1·4725	1·465 to 1·470	1·466 to 1·470	1·463 to 1·473 (at 25° C.)
Acid value	0·9	0·5 to 2	0·5 to 1·5	1 to 2	—
Ester value	3·0	3 to 14	5 to 20	2·3 to 17·5	—
Esters (expressed as bornyl acetate) *per cent.*	1·0	1 to 5	1·8 to 7	0·8 to 6	Not less than 1·8
Ester value after acetylation	28·3	—	—	—	—
Total alcohols (expressed as borneol) *per cent.*	7·9	8 to 19	8 to 18	10 to 20	Not less than 10
Solubility in 80 per cent. alcohol at 15° C.	Slight turbidity with 11 vols.	Usually soluble with at most faint turbidity in from 1 to 10 vols.			Soluble in 5 to 10 vols.

A sample of the oil was submitted to a firm of essential oil merchants who reported that it contains rather more terpenes than usual, but that its odour is good and that the oil is comparable with that produced in Spain. They added that the value of Spanish oil is about 1*s.* 10*d.* to 2*s.* per lb. (February, 1927), and that a similar price should be obtainable for the South African oil.

This sample of rosemary oil was of fair quality, but contained a comparatively low percentage of borneol, and also differed in certain other respects from the best oils of rosemary. It would, however, be saleable at a price approximating to that of the Spanish oil.

With reference to the yield of oil obtained on distilling the fresh branches at Kirstenbosch, viz. 0·52 per cent., it may be mentioned that the material is generally sun-dried before distillation and then yields about 1·2 to 2·0 per cent. of oil.

3. Oil of *Pittosporum undulatum* Fruits from South Africa

A sample of oil distilled from the ripe fruits of *Pittosporum undulatum* was received from the Director of the National Botanic Gardens, Kirstenbosch, in November, 1926.

It was stated that the fruits give a considerable yield of volatile oil, 220 cc. having been obtained experimentally from 70 lb. 13 oz. of the ripe fruits (or approximately 0·6 per cent.).

P. undulatum is a small tree, native to Australia, where it is known as "mock orange." It is sometimes cultivated for its sweet-smelling flowers.

The oil received at the Imperial Institute was limpid, clear, and almost colourless; it had an odour faintly resembling that of oil of mandarin orange, but less pleasant.

On examination, the oil furnished constants which are given in the following table in comparison with those obtained by Power and Tutin (*Journ. Chem. Soc.*, 1906, **89**, 1083) for oil distilled from unripe fruits of *Pittosporum undulatum*.

	Present sample of oil from ripe fruits.	Oil from unripe fruits (Power and Tutin).
Specific gravity at 15/15°	0·8682	0·8615
Optical rotation α_D	+ 83·5°	+ 74·1°
Refractive index $n_D 20°$	1·4795	—
Acid value	1·4	—
Ester value before acetylation	14·6[1]	—
Ester value after acetylation	47·1[2]	—
Solubility in 70 per cent. alcohol	Insoluble in 10 vols.	Insoluble in 10 vols.
Solubility in 90 per cent. alcohol at 15°	1 in 5·3 vols.	

[1] *Equivalent to* 5·1 *per cent. of esters calculated as* $C_{10}H_{17}OAc$.

[2] *Equivalent to* 13·4 *per cent. of total alcohols calculated as* $C_{10}H_{18}O$.

On distilling the oil under ordinary atmospheric pressure, the following fractions were obtained:

Fraction.	Per cent.
1. Up to 173° C.	8
2. 173° to 179° C.	67
3. 179° to 185° C.	9
4. Above 185° C.	16

Fraction 2 had a characteristic odour of limonene, a terpene which boils at 175° to 176° C.

On treating a portion of the original oil with sodium bisulphite, about 2 per cent. of the oil was absorbed, the presence of a small quantity of an aldehyde or ketone being thus indicated.

On shaking another portion of the original oil with

5 per cent. solution of caustic soda, about 2 per cent. of a phenolic substance was removed; the amount, however, was insufficient for detailed examination.

Samples of the oil were submitted to essential oil merchants and manufacturers for opinions as to its possible commercial value. They reported that although the oil possesses a pleasant odour it is not likely to find any definite use in perfumery, and as it consists largely of terpenes it would be of very little industrial value. One of the firms stated that if they could be informed as to the lowest price at which the oil could be offered they would endeavour to ascertain whether a market could be found for it.

The preliminary examination described above has shown that the oil from the ripe fruits of *Pittosporum undulatum* contains about 75 per cent. of low boiling terpenes and is on the whole similar in composition to the oil from the unripe fruits examined by Power and Tutin. The Mauritius oil, however, contained more esters and alcoholic constituents than that examined by Power and Tutin, and also a small quantity of an aldehyde or ketone.

As the oil consists largely of terpenes and possesses no special characters which would render it of value in perfumery, it seems improbable that it could be profitably exported unless it could be produced very cheaply. The authorities in South Africa have been informed that if particulars can be supplied as to the lowest price at which it would be possible to supply the oil commercially, the Imperial Institute will be glad to consider the question further.

4. Palmarosa Oil from Seychelles

Two samples of palmarosa oil were received from the Director of Agriculture, Seychelles, during 1926.

Each sample consisted of a clear, pale brownish-yellow oil with the characteristic odour of palmarosa oil.

On examination the oils furnished the results given in the following table in comparison with those recorded by Gildemeister (*The Volatile Oils*) for commercial palmarosa oil.

	Sample No. 1.	Sample No. 2.	Palmarosa oil. Recorded figures.
Specific gravity at 15/15° C.	0·902	0·890	0·887 to 0·900
Optical rotation α_D	+ 0·3°	nil	+ 6° to − 3° mostly between + 1° and − 2°
Refractive index $n_D 20°$	1·477	1·473	1·472 to 1·476
Acid value	4·2	—	0·5 to 3·0
Ester value before acetylation	54·6	—	12 to 48
Ester value after acetylation	263·1	266·8	226 to 274
Total acetylisable constituents, calculated as geraniol . . *per cent.*	90·1	91·6	74·8 to 94·8
Solubility in 70 per cent. alcohol at 15°	Soluble in 1·6 vols.	Soluble in 1·5 vols.	Soluble in 1·5 to 3 vols.

These results show that the constants of both oils agree with those of genuine palmarosa oil, and that they contain a satisfactorily high proportion of acetylisable constituents. Both oils were of good quality, but their odour was not so "heavy" as certain palmarosa oils of India. They would probably realise a price similar to that of ordinary commercial palmarosa oil, which was then quoted in London at 8*s.* 9*d.* to 9*s.* per lb. (April, 1927).

5. Gingergrass Oil from Seychelles

A sample of gingergrass oil which had been produced in Silhouette Island, Seychelles, from plants grown from Indian seed, was received from the Director of Agriculture in August, 1926. It consisted of a clear, pale yellowish-brown oil, having an odour resembling that of ordinary gingergrass oil.

On examination the oil furnished constants which are given in the following table in comparison with those recorded by Gildemeister (*The Volatile Oils*) for gingergrass oil.

	Present sample.	Gingergrass oil. Recorded figures.
Specific gravity at 15/15° C.	0·942	0·900–0·953
Optical rotation α_D	+ 25·0°	+ 54° to − 30°
Refractive index $n_D 20°$	1·492	1·478–1·493
Acid value	3·4	Up to 6·2
Ester value before acetylation	10·4	8 to 29
Ester value after acetylation	156·6	120 to 200
Total acetylisable constituents calculated as geraniol, *per cent.*	48·8	36·2 to 64·7
Solubility in 70 per cent. alcohol at 15°	Soluble in 2·4 vols.	Soluble in 2 to 3 vols.

These results show that the constants of the present sample of oil correspond with those of gingergrass oil of fairly good quality.

6. Fennel Seed from South Africa

A sample of fennel fruits or "seed" grown at the National Botanic Gardens, Kirstenbosch, was received at the Imperial Institute in December, 1922. The seed was found to furnish a good yield of essential oil, viz. 6·5 per cent. against a recorded normal figure of 4 to 6 per cent. Comparison of the seed with commercial Indian and Syrian varieties showed, however, considerable differences between the products, and this was confirmed by commercial experts consulted by the Imperial Institute, who did not consider that the sample could be regarded as ordinary fennel seed.

In view of the unusual character of the seed, the Imperial Institute forwarded a specimen to the Director of the Royal Botanic Gardens, Kew, who stated that it appeared to consist of true fennel (*Foeniculum vulgare*), and this view was confirmed from an examination of seedlings grown at Kew from the seeds supplied.

Samples of the Indian and Syrian varieties of ordinary fennel seed were furnished by the Imperial Institute to the Kirstenbosch Gardens, where they were grown in comparison with the local kind. Whereas the latter grows habitually to a height of about 6 ft., it was found that the Indian and Syrian varieties only reached a height of 12–18 in., and had a much more delicate type of foliage. The difference in the plants was so great that the Director of the Gardens considers that the plants may be specifically distinct.

Seed of the three kinds, harvested in April, 1925, were subsequently received at the Imperial Institute. The sample of local seed was similar in colour, odour and general appearance to that received in 1922, and like the latter was more camphor-like in taste and smell than the Syrian and Indian seeds. The samples of the latter forms which had been grown in South Africa differed from the seed originally sent out by the Imperial Institute in being darker in colour, and slightly sweeter

in odour, possibly from having been gathered in a riper condition.

In order that a fuller examination of the South African seed could be made, a larger sample was forwarded from the National Botanic Gardens, Kirstenbosch, towards the close of 1925.

The sample, which weighed 19 lb., consisted of fennel fruits or "seed" of dull brown colour. The general appearance and odour were similar to those of the previous samples grown from local seed in South Africa.

The product was examined with the following results, which are given in comparison with those obtained with the previous sample forwarded in 1922, and with those recorded by Parry (*The Chemistry of Essential Oils*) for fennel seed :

—	Fennel seed from South Africa.		Commercial fennel seed. (European).
	Present sample.	Previous sample.	
Seed :			
Yield of volatile oil, on steam distillation . . *per cent.*	4·5	6·5	4 to 6
Ash . . . . *per cent.*	6·0	4·6	*
Oil :			
Specific gravity at 15/15° C. .	0·977	0·976	0·964 to 0·976
Optical rotation α_D . . .	+ 15·4° at 18° C.	+ 11·3° at 20° C.	+ 6° to + 20° (rarely + 26°)
Refractive index $n_D 20°$ C. . .	1·536	1·542	1·528 to 1·538
Congealing point, ° C. . . .	+ 7·5	+ 10	+ 3 to + 10
Melting point, ° C. . . .	+ 9·5	+ 12·8	—

* *The British Pharmacopœia specifies that the ash must not exceed 11 per cent.*

The seed was somewhat inferior in quality to the earlier sample, being smaller and furnishing a lower yield of volatile oil.

The oil was limpid, almost colourless, and had a strong anise odour which was, however, distinctly camphoraceous. The odour resembled that of the oil from the previous sample of seed, but was less pleasant and not so pungent.

An investigation of the oil was made in order to determine its constituents in comparison with those of the oil of fennel seed from other sources.

The principal constituents of fennel oil are fenchone and anethole, and the South African oil was found to

contain 17·5 per cent. of fenchone and approximately 56 per cent. of anethole.

The percentages of fenchone in the oil of fennel seed from various sources are shown in the following table:

Source of seed.	Fenchone. Per cent.
South Africa (present sample)	17·5
Saxony	22·5
Galicia	18·1–19·3
Russia	18·2
Japan	10·2
India	6·7
Persia	3·4
France	nil

The oil from the best varieties of commercial fennel seed (viz. Saxon, Galician and Russian) generally contains between 50 and 60 per cent. of anethole.

It will be seen from the results given above that the constants of the South African oil were normal for fennel oil, and that the oil contains similar amounts of the chief constituents, anethole and fenchone, to those occurring in the oils of the best commercial grades of fennel seed.

Although enquiries have been made in many directions it has not been possible to obtain any definite opinion as to the probable market for the seed in this country, or the price which it would be likely to realise, owing to the fact that its appearance and odour differ considerably from those of commercial fennel seed, with which it would have to compete. No reliable information can be obtained as to the extent of the trade in fennel seed, and no statistics of imports into the United Kingdom are available.

A firm of drug merchants stated that there is a large sale for fennel seed in this country, but they were of opinion that the dark colour of the present sample from South Africa might militate against its use for cattle medicines. Another firm considered that there would be difficulty in obtaining a market for this seed, especially as there is a plentiful supply available from other sources.

Two other firms expressed the opinion that fennel seed is little used as a condiment in cattle foods owing to its high price, but one of them suggested that there would be a good demand if supplies could be landed in this

country at about £15–£20 per ton, as compared with the current price of £25–£28 per ton (April, 1926). Merchants dealing in fennel seed expressed the opinion that the South African seed might be utilised for cattle cake, but pointed out that, even if manufacturers could be induced to use it, its value would be lower than that of the usual commercial kinds on account of its appearance. They estimated that it would only realise about £15–£25 per ton in the United Kingdom. A firm of cattle cake manufacturers valued the seed at £25–£30 per ton; they stated that they were only small users of the seed, but offered to take a few bags (say up to ½ ton) for trial.

Brokers who were consulted reported that it is difficult to estimate either the probable demand for this seed from South Africa or the price which it would realise in this country. They suggested that the best course to adopt would be to forward a trial consignment to test the market.

General Remarks

The results of this investigation have shown that the South African fennel seed differs in appearance and odour from that usually marketed in the United Kingdom, and, in view of the diverse opinions expressed by the commercial firms consulted, it is impossible to say whether the product would meet with any considerable demand. It has been pointed out to the authorities in South Africa that the best means of ascertaining the market possibilities would be to forward a small consignment (up to 1 ton) to this country for trial sale in London.

7. Fennel Seed from Southern Rhodesia

The fennel seed which is the subject of this report was received at the Imperial Institute in November, 1926, from the High Commissioner for Southern Rhodesia. It was stated that the plant grows like a weed in certain areas, and that the seed could be obtained in large quantities. The sample was derived from wild plants which were cut before they were fully ripe. It was desired that a report should be furnished on the quality and commercial value of the seed.

The sample consisted of brown fruits (or " seed ")

with a greenish tint, and varying from 2 to 6 mm. in length and from 0·5 to 3 mm. in breadth.

The fruits were smaller and darker than the principal commercial varieties of fennel, and the odour was less strong and more camphoraceous.

On distillation with steam the crushed seed furnished 5·4 per cent. of a pale yellow, limpid oil, the constants of which are shown in the following table in comparison with those of the two samples of fennel seed from South Africa dealt with in the preceding pages, and with the usual constants of sweet fennel oil (*Foeniculum vulgare*) from European seed, as recorded by Parry (*The Chemistry of Essential Oils*).

	Present sample.	Fennel oil from South African seed. No. 1.	No. 2.	Recorded figures for fennel oil.
Specific gravity at 15/15° C.	0·967	0·977	0·976	0·964 to 0·976
Optical rotation a_D .	+ 21·6°	+ 15·4°	+ 11·3°	+ 6° to + 20° (rarely + 26°)
Refractive index $n_D 20°$ C.	1·526	1·536	1·542	1·528 to 1·538
Congealing point, ° C. .	+ 2	+ 7·5	+ 10	+ 3 to + 10
Melting point, ° C. .	+ 4	+ 9·5	+ 12·8	—

This fennel seed from Rhodesia closely resembled the samples from the Union of South Africa. It furnished a good yield of oil (5·4 per cent.), which compares favourably with that usually obtained (4 to 6 per cent.) from the best commercial varieties. The oil was inferior in quality to that yielded by the South African seed and had a lower congealing point, indicating that it contained a comparatively low percentage of anethole.

The present seed is darker and has a different odour from the fennel seed usually marketed in Great Britain and, as stated in connection with the South African seed (p. 116), such seed might not be readily saleable in London. It was suggested, however, that it would be worth while to obtain and forward a sample of the ripe fruits with a view to ascertaining whether these approach more closely to the usual types.

8. Dill Seed from Southern Rhodesia

A sample of dill seed grown at the Salisbury Experiment Station was received at the Imperial Institute in November, 1926, from the High Commissioner for Southern Rhodesia.

It consisted of yellowish-brown, flat, oblong fruits (or "seed") from 3 to 5 mm. long, and from 2 to 3 mm. broad. It possessed the appearance and odour of ordinary dill seed.

On distillation with steam, the crushed seed yielded 2·6 per cent. of a pale brownish-yellow, limpid oil which had the characteristic odour of dill oil.

The oil furnished the following constants, which are shown in comparison with the usual constants of European dill oil (*Peucedanum graveolens*) as recorded by Parry (*The Chemistry of Essential Oils*), and with the requirements of the British Pharmacopœia for dill oil :

	Present sample.	Recorded figures for European dill oil.	Requirements of the British Pharmacopœia.
Specific gravity at 15/15° C.	0·913	0·895 to 0·918 (rarely below 0·903)	0·900 to 0·915
Optical rotation a_D	+ 75°	+ 70° to + 82°	+ 70° to + 80°
Refractive index n_D	1·488 (at 20° C.)	1·485 to 1·490 (at 20° C.)	1·483 to 1·488 (at 25° C.)
Carvone (estimated by the normal sulphite method) *per cent.*	56	30 to 60	—
Solubility in 90 per cent. alcohol at 15° C.	1 vol. in 0·25 vol.	—	1 in 3 vols.

The seed was submitted to two firms of wholesale druggists and manufacturers for their opinions as to its commercial value and market possibilities. Both firms stated that the seed appeared to be of very good quality, resembling that imported from Europe, but that at present there is very little demand for it in this country. One firm estimated its value as about 25*s*. per cwt., and the second firm offered to report more fully as to the quality and value if ½ to 1 cwt. of the seed could be supplied to them for technical trial.

This sample of dill seed from Southern Rhodesia resembled commercial samples of European dill seed, but was slightly paler. The yield of oil obtained on distillation (2·6 per cent.) was rather lower than that usually obtained from dill seed (3 to 4 per cent.). The oil, which possessed all the characters of European dill oil, had a good aroma and contained a good percentage of carvone.

It complied with the requirements of the British Pharmacopœia.

The results of this investigation show that this dill seed from Rhodesia is of good quality and would probably be saleable in this country in competition with the European seed. At present, however, there is little demand for the seed in the London market, and the conditions are therefore unfavourable for forwarding a consignment for trial sale.

CHENOPODIUM OIL FROM MAURITIUS

A SAMPLE of the oil of *Chenopodium ambrosioides*, distilled in March, 1925, at the Experimental Station, Pamplemousses, was received in November, 1926. A memorandum by Mr. N. Craig, M.Sc., Agricultural Chemist in Mauritius, on the distillation of the oil was furnished to the Imperial Institute, in which it was stated that a yield of 242 cc. of oil was obtained from 17 kilos. of leaves and seeds, corresponding to 1·4 per cent. The results of an examination of the oil were also included in the memorandum.

It was desired that the sample of oil should be investigated at the Imperial Institute and that information should be supplied regarding the commercial prospects of the oil in Europe.

The sample consisted of a golden yellow oil which had the characteristic taste and odour of chenopodium oil.

The results of the examination of the oil are given in the table on p. 121, which also includes the corresponding figures found by Mr. Craig, those furnished by a sample of chenopodium oil purchased in London, and the requirements of the United States Pharmacopœia.

These results show that the present sample of the oil from Mauritius contains a lower percentage of ascaridole than the oil purchased in London, and that it does not fulfil the requirements of the United States Pharmacopœia in this respect. It will also be observed that the constants now obtained differ to some extent from those found by the Chemist in Mauritius, but it must be borne in mind

—	Oil from Mauritius. Present sample.	Oil from Mauritius. Results obtained by Mr. Craig.	Purchased sample.	Requirements of the United States Pharmacopœia.
Specific gravity at 25/25° C.	0·9591	0·9539[1]	0·9661	0·955–0·980
Optical rotation at 25° C. (100 mm. tube)	− 3·0°	− 6·2°	− 4·4°	− 4° to − 10°
Refractive index at 20° C.	1·478	1·474	1·476	1·4723–1·4770
Solubility in 70 per cent. alcohol at 25° C.	1 in 13	—	1 in 3	1 in not more than 8
Ascaridole, per cent. determined by U.S. Pharmacopœia method	61·8	—	66·8	Not less than 65
Do. Paget's method[2]	59·7	64·6	65·9	—

[1] *At* 29° *C.* [2] *Analyst*, 1926, **51**, 170.

that the examination of the oil in Mauritius was carried out some time ago. The oil appears to have deteriorated in the interval, as would be expected, since ascaridole readily undergoes chemical change.

Enquiries in the trade have shown that there is a small but fairly regular import of the oil into this country, the greater part of which is re-exported, the demand for home consumption being very small.

It is estimated that the average total consumption is about 50,000 lb. per annum. The price of the oil fluctuates very considerably, and is at present lower than it has been for several years, as is shown by the following figures:

	Price per lb.
Pre-War	6*s.* 9*d.* to 9*s.*
1921	18*s.* 6*d.* to 37*s.* 6*d.*
1922	12*s.* 9*d.* to 18*s.* 6*d.*
1923	12*s.* 9*d.* to 32*s.* 6*d.*
1924	19*s.* 9*d.* to 33*s.* 6*d.*
1925	14*s.* 3*d.* to 16*s.* 3*d.*
1926	17*s.* to 25*s.*
1927 (to May)	12*s.* 3*d.* to 13*s.* 9*d.*

The oil was quoted in London at 12*s.* 3*d.* per lb. in May, 1927.

This sample of chenopodium oil, as received at the Imperial Institute, did not fully satisfy the requirements of the United States Pharmacopœia, probably owing to deterioration during the period which had elapsed since it was distilled.

The quality of chenopodium oil is largely influenced by the method of preparation and as the oil is somewhat

subject to adulteration purchasers attach great importance to the percentage of ascaridole. It is therefore necessary to ensure that the oil produced is of high quality.

It is desirable, as suggested in Mr. Craig's memorandum, that the distillation should be conducted as rapidly as possible. In the United States the best results are stated to be obtained by distillation with steam under a pressure of 60 to 120 lb., under which conditions the operation is completed in about 15 minutes. Sometimes warm water is used in the condenser in order to effect a rapid separation of oil from the distillate. It is stated that during recent years metal stills have come into use and that between 300 and 500 lb. of the herb are distilled at each operation.

The demand for chenopodium oil is chiefly from South America and the Far East. Dr. Andrew Balfour, Director of the London School of Hygiene and Tropical Medicine, has informed the Imperial Institute that chenopodium oil has now been largely replaced by carbon tetrachloride in the treatment of ankylostomiasis, but that it still remains an excellent remedy for ascaris and other forms of helminthic infection. He considers that there is likely to be a special demand for the oil in Egypt, East and West African Colonies, India, Ceylon, Malaya, China and Japan.

Dr. Balfour adds that chenopodium oil has been used recently for the treatment of tropical ulcer, and that very good results have been reported from its use, especially in South America.

The Mauritius authorities have been informed that if particulars can be furnished as to the quantity of oil which could be produced annually in Mauritius the Imperial Institute will be glad to make further enquiries as to the marketing of it in London. It would be essential that the oil should contain not less than 65 per cent. of ascaridole.

ALPINIA NUTANS FOR PAPER-MAKING

A sample of the dried stems of a plant which has been provisionally identified by the Superintendent of Agriculture for the Leeward Islands as *Alpinia nutans*, Roxb.

(natural order Zingiberaceæ), was forwarded to the Imperial Institute recently from Montserrat, in order to ascertain the value of the stems for paper-making.

Alpinia nutans is a native of Malaya and the tropics to the east of that country, and has been introduced into India, the West Indies and parts of Central and South America, where it now occurs in the wild state. It was introduced into Montserrat in 1901, and is stated to grow freely in that island, giving a large yield of stems per acre.

Clayton Beadle and Stevens examined the stems as a paper-making material some years ago in comparison with the related plant *Hedychium coronarium*. Although inferior to the latter it was considered that the stems might nevertheless be a quite useful source of material for the paper-maker (*Kew Bulletin*, 1912, p. 377).

The possibility of utilising the stalks as a source of textile fibre was investigated in St. Helena in 1917 (*Colonial Office Report on St. Helena for* 1918, p. 5). A stripping machine used for extracting fibre from the leaves of *Phormium tenax* was modified to deal with Alpinia stalks, which were successfully treated during a period of nine weeks, when there was a shortage of Phormium in the island. The yield, however, was low, only 3 tons 16 cwt. of fibre and 7 tons 14 cwt. of tow being obtained from 255½ tons of stalks. The fibre realised £70 and the tow £50 per ton, but these prices were exceptionally high, owing to war conditions, and it was considered that in normal times the extraction of fibre from the stalks would not be remunerative.

The material received for examination from Montserrat consisted of dried fibrous stems which had been crushed. The stems were pale yellowish-brown, about 7 in. long, and contained a large amount of pithy matter.

The material was chemically examined with the following results :

	Per cent.
Moisture	9·0
Ash	6·25
Cellulose in material as received . .	49·9
Cellulose expressed on the moisture-free material	54·8

subject to adulteration purchasers attach great importance to the percentage of ascaridole. It is therefore necessary to ensure that the oil produced is of high quality.

It is desirable, as suggested in Mr. Craig's memorandum, that the distillation should be conducted as rapidly as possible. In the United States the best results are stated to be obtained by distillation with steam under a pressure of 60 to 120 lb., under which conditions the operation is completed in about 15 minutes. Sometimes warm water is used in the condenser in order to effect a rapid separation of oil from the distillate. It is stated that during recent years metal stills have come into use and that between 300 and 500 lb. of the herb are distilled at each operation.

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Clayton Beadle and Stevens examined the stems as a paper-making material some years ago in comparison with the related plant *Hedychium coronarium*. Although inferior to the latter it was considered that the stems might nevertheless be a quite useful source of material for the paper-maker (*Kew Bulletin*, 1912, p. 377).

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The material received for examination from Montserrat consisted of dried fibrous stems which had been crushed. The stems were pale yellowish-brown, about 7 in. long, and contained a large amount of pithy matter.

The material was chemically examined with the following results :

	Per cent.
Moisture	9·0
Ash	6·25
Cellulose in material as received	49·9
Cellulose expressed on the moisture-free material	54·8

The ultimate fibres had the following dimensions :

	Length. mm.	Diameter. mm.
Maximum	6·2	0·0508
Minimum	0·6	0·0050
Average	2·62	0·0162

The crushed stems as received were treated with caustic soda solution under conditions similar to those employed for the production of paper-pulp on a commercial scale. The results, expressed on the material as received, are given in the following table :

Trial.	Caustic soda used.		Conditions of digestion.		Parts of caustic soda consumed per 100 parts of material.	Yield of dry pulp.	
	Parts per 100 parts of stems.	Parts per 100 parts of solution	Time	Temp		Un-bleached	Bleached.
			hrs	° C.		*Per cent*	*Per cent*
A	12	3	6	160	12·0	—	—
B	20	3	3½	140	10·6	46	40
C	20	3	5	140	11·6	43	37
D	20	3	5	160	12·5	41	32

The conditions of Trial A were not sufficiently severe, with the result that the material was not completely reduced, and the whole of the caustic soda was consumed. An attempt was made to obtain a pulp suitable for paper from this imperfectly digested material by a drastic beating treatment, and this resulted in the production of a strong, coarse, brown paper containing much incompletely disintegrated fibre.

The conditions of digestion in Trial B did not effect a complete disintegration of the material. The pulp obtained furnished a pale brown paper of excellent strength, but still contained some imperfectly digested fragments. The pulp did not bleach satisfactorily, and when treated with a strong bleaching solution the colour was only reduced to a dark cream.

The increased time of digestion in Trial C did not alter the character of the unbleached pulp to any marked extent. The pulp furnished a similar pale brown paper to that obtained in Trial B, but it bleached fairly readily and yielded a pale cream-coloured paper.

The more severe conditions employed in Trial D

enabled a pale brown paper of excellent strength to be produced which was practically free from particles of undisintegrated fibre. The pulp bleached readily and yielded a white paper.

These trials show that the *Alpinia nutans* stems can be converted into paper of very satisfactory quality. They yield a pulp of which the ultimate fibres are similar in average length to the fibres of coniferous wood pulps; it somewhat resembles spruce pulp, but furnishes a paper which is stronger, more transparent and more "rattly." The yield of pulp is fairly good, whilst the consumption of caustic soda is not excessive.

When submitted to a mild digestion with caustic soda (as in Trial B) the stems would furnish a good yield of unbleached pulp suitable for the manufacture of strong wrapping paper, whilst on more severe treatment, similar to the conditions employed in Trials C and D, the pulp produced would, after bleaching, be suitable for the manufacture of writing paper and other thin white papers of good quality.

The *Alpinia nutans* stems are very similar to those of the allied plant, *Hedychium coronarium*, but, according to the report on the latter by Clayton Beadle and Stevens (*Kew Bulletin*, 1912, p. 373; *Jour. Roy. Soc. Arts*, 1913, **61**, 352–359), Hedychium appears to give a somewhat higher yield of pulp than the present material, the pulp being of superior quality and consisting of fibres with a slightly higher average length than those of Alpinia.

It is not possible to state a commercial value for the *Alpinia nutans* stems, as the pulp which they yield is of a different character from that furnished by esparto (the only material now imported in an unprepared condition into the United Kingdom for paper-making) which was quoted at from £4 to £6 5*s*. per ton c.i.f. United Kingdom ports in April, 1927. It would be necessary for large-scale trials to be carried out in order to determine the value of Alpinia stems to British paper-makers. It seems unlikely, however, that in any case it would be remunerative to export the stems themselves owing to the bulky nature of the material and the heavy cost of transport, but if the pulp should prove attractive to paper-

makers in this country, it might be worth while to consider the preparation of the pulp (or half-stuff) in Montserrat. The success of the enterprise would, of course, depend on the yield of stems available per acre, and the cost of converting it into half-stuff under local conditions. It would probably be advisable in the first instance to have a technical trial carried out at a paper mill in this country, and the authorities in the Leeward Islands have been informed that the Imperial Institute would be pleased to arrange for such a trial if a consignment of at least two tons of the stems could be supplied for the purpose.

CHINA-CLAY FROM SOUTH AFRICA

DEPOSITS of china-clay have been found in several localities in the Union of South Africa, and the following report deals with a sample of material from an occurrence at Claremont, near Cape Town.

The sample, which was received through the Trade Commissioner for the Union of South Africa in London, was sent to the Imperial Institute in order that it might be compared with Cornish china-clay of good quality, and its commercial possibilities investigated.

The sample, as received, consisted of a white china-clay contaminated with quartz sand in fragments up to $\frac{1}{10}$ in, in diameter. It was evident that the raw material would need purification before it could be employed for purposes similar to those for which Cornish china-clay is used, and trials were therefore carried out in the Imperial Institute ceramic laboratory in order to ascertain what degree of improvement could be effected by careful washing.

Washing Experiments.—Comparative trials were carried out on samples of the South African raw clay and Cornish china-clay rock, the speed of the current of water being such as had been found necessary to remove the fine clay from the English raw material. Under these conditions the South African clay left 8 per cent. of residue, whilst the Cornish rock yielded about 57 per cent.

The washed clay yielded by the South African material

had the same appearance as refined Cornish china-clay, but contained rather more grit, a feature detrimental to its employment as a high-grade filler. With a view to eliminating this defect, further washing trials were made, using a much slower speed of water current for washing. Under these conditions the clay gave a residue of 15 per cent. The washed clay, however, was still much more gritty than refined Cornish china-clay of good quality, and a chemical analysis showed that it had practically the same chemical composition as the clay produced in the first trial by washing the raw material in a more rapid current of water. It is evident, therefore, that by further diminishing the speed of the current, a lower yield of refined product would be obtained without appreciable improvement in quality.

The washed South African clay was similar in texture and colour to commercial samples of second-grade English china-clay used in the manufacture of the best grades of newspaper. It had the advantage, however, that it remained suspended in water for a longer period than did the English commercial sample.

As it appeared evident that no further appreciable improvement would be effected by alterations in the mode of washing the clay, experiments were carried out in order to determine whether a material of better texture could be produced by other means.

Trials were therefore made with deflocculation processes, and it was found that considerable improvement could be effected in the physical condition of the clay.

The clay was mixed with water containing a very small quantity of sodium silicate, this treatment causing deflocculation of the fine clay, which remained in suspension whilst most of the gritty particles rapidly settled out and were removed. The purified clay could then be recovered by electrical osmose treatment or by adding to the solution a coagulant such as a weak solution of aluminium sulphate.

Technical Trials.—In order to determine the suitability of the washed clay (not deflocculated) for use in the manufacture of earthenware and china, the following mixtures were made, using the washed South African clay :

(1) *Earthenware:*

	Per cent.
South African clay	35
Dorset ball clay	30
Flint	20
Cornish stone	15

(2) *China:*

South African clay	30
Bone ash	35
Cornish stone	35

Similar mixtures were also made, using English china-clay in place of the South African material, and vessels moulded from the earthenware and china mixtures were fired to a temperature of about 1,150° C. and 1,250° C. respectively.

It was found that there was little difference in appearance between the earthenware made with the South African clay and that made with the English kaolin. A somewhat lower firing temperature, however, would be adequate, as the ware produced at the temperature employed was not quite sufficiently permeable for the satisfactory application of a glaze.

The drying and firing shrinkages of the raw South African clay and of the South African earthenware mixtures were determined, and are shown below in comparison with those of English kaolin and the English earthenware mixtures:

	Drying shrinkage. *Per cent*	Additional shrinkage on firing *Per cent.*	Total shrinkage. *Per cent*
South African clay	3·8	7·5	11·3
English kaolin	1·9	5·6	7.5
South African earthenware	3·8	8·1	11·9
English earthenware	3·1	7·5	10·6

It will be seen that South African clay and the earthenware mixture made therefrom had somewhat higher shrinkages than those of the corresponding products containing Cornish china-clay, but the difference in shrinkage between the two earthenwares was not sufficiently great to be of any practical importance.

The bone china produced from the South African clay by firing at a temperature of about 1,250° C. and covering with a felspathic glaze was similar in appearance to that made with English kaolin.

Summary and Conclusion.—The raw china-clay from Claremont, on washing, gave a high yield of china-clay which could be used in the manufacture of china and fine earthenware.

The washed clay, however, was in all cases rather gritty, and would be comparable only with second-grade Cornish kaolin used as a filler for high-grade newspaper.

Extensive experiments were made with a view to obtaining a better product, and it was found that this could be effected by deflocculation processes.

NICKELIFEROUS ROCKS FROM THE SOCIETY ISLANDS

So far as can be ascertained, the occurrence of nickel-bearing rocks at this locality has not been previously recorded, and in these circumstances the following note on some work carried out at the Imperial Institute may be of interest.

The four samples were sent to the Imperial Institute by the Acting British Consul at Tahiti, Society Islands, who stated that quantities of nickel varying from 1 to 2 per cent. had been recorded for similar rocks found in the Islands. The present samples were sent in order that the mode of occurrence of the nickel might be investigated.

The samples received were labelled " B," " M," " F " and " 230," the first three being from Rapa, whilst the last came from Mangareva, both these islands being in French Oceania.

Samples " B " and " 230 " were amygdaloidal olivine-basalts. " F " was a similar rock in which the vesicles had been filled with secondary quartz. Specimen " B " was a more coarsely crystalline rock, an olivine gabbro (perhaps norite). In all these rocks the olivine was present as large porphyritic crystals, accompanied by pyroxene. Olivine was most abundant in sample " 230," making up nearly 50 per cent. of the rock; it was least evident in sample " B."

In all cases the olivine showed alteration around the outside of the crystals, and there was a thin reddish or bronze-yellow iridescent film coating and filling cracks in the crystals.

As the presence of nickel minerals in these rocks was not evident, chemical analyses were made, and these showed that No. 230 was richest in nickel, containing 0·81 per cent. of nickel oxide (NiO), whilst " F," " M " and " B " contained 0·30, 0·09 and 0·05 per cent. respectively. In no case, therefore, was there sufficient nickel present to render the rock workable as an ore, although samples " 230 " and " F " may be said to contain somewhat exceptional amounts for basic igneous rocks.

Chemical examination of these samples showed that (1) no sulphides or arsenides were present, and (2) the olivine was rich in nickel. No quantitative chemical analysis of the separated olivine was made, but it is unlikely that the percentage of nickel oxide in it would exceed 0·3 or 0·4, and as this would be insufficient to account for the whole of the nickel in these rocks it appears probable that nickel also occurs here associated with minerals other than olivine. In this connection it may be mentioned that the lining walls of vesicles in these basalts show thin films of secondary material coating the walls of the vesicles. These films, which are greyish in colour and appear to be chiefly silica, may possibly contain small amounts of some one or other of the rather indefinite hydrated nickel magnesium silicates.

ARTICLE

THE DEVELOPMENT OF BAST AND LEAF FIBRE CULTIVATION IN THE BRITISH EMPIRE[1]

By Ernest Goulding, D.Sc. (Lond.), F.I.C.,
Imperial Institute

PART II

Leaf Fibres

Manila Hemp

Manila hemp is derived from the sheathing leaf-stalks of *Musa textilis*, a plant of the banana or plantain family. It is produced almost exclusively in the Philippine Islands, and in order to ensure the continuance of the monopoly an Act was passed by the Philippine legislature in 1926 prohibiting the exportation of the seeds.

From time to time, attempts have been made to introduce it into other countries, but usually with little or no success. In the year 1822 an effort was made to grow the plant in Bengal, and in 1859 it was introduced into Madras, but in neither case was a satisfactory result obtained. In 1873 an experimental trial was made in the Andaman Islands, and the plant proved to be well adapted to this locality. The cultivation of the plant and the preparation of its fibre in the Andaman Islands, however, have never become an important industry, and but little attention is paid to it.

Attempts have also been made to introduce the plant into North Borneo, New Guinea, the Federated Malay States and the West Indies, and small experiments have been made in Ceylon, Fiji, the Solomon Islands and various other parts of the British Empire.

North Borneo.—Experiments which have been carried out in North Borneo have shown that the Manila hemp plant grows well on the volcanic soils of the country, but does not give good results on other lands. The crop has been planted on a small scale, and encouraging reports

[1] A Public Lecture delivered to the London Section of the Textile Institute at the Clothworkers' Hall on February 7, 1927. Printed by the courtesy of the Editor of the *Journal of the Textile Institute*.

Part I of this article, dealing with Bast Fibres, was published in the preceding issue of this Bulletin (Vol. XXV, No. 1, pp. 14–31).

have been made on fibre extracted in 1925 indicating that a product can be obtained in North Borneo comparable with that exported from the Philippines. Borneo planters are not inclined to interest themselves in Manila hemp, owing to their preference for rubber-growing. One estate, however, is cultivating it in small quantities with some success, and it is expected that in the near future a company will be organised for the sole purpose of Manila hemp production.

New Guinea.—Attempts are being made to grow the Manila hemp plant in New Guinea. In order to encourage the industry, an Act was passed early in 1926 providing for the payment of a bounty of £6 per ton on fibre produced in the Territory of Papua or the Territory of New Guinea on direct importation into Australia for home consumption there.

Federated Malay States.—Experimental trials with *Musa textilis* have been carried out recently at the Government Experimental Plantation at Serdang, but the results are not yet sufficiently conclusive to justify the cultivation on a commercial scale.

Banana and Plantain Fibres

Besides the Manila hemp plant, there are several other species of Musa which bear fibrous leaf-sheaths. Among these the most common is the ordinary fruiting banana. The fibre extracted from this plant is, however, generally much weaker than Manila hemp, and would be of comparatively little value for cordage manufacture. There are enormous quantities of banana stems cut down after the fruit harvest and thrown away, which presumably might be employed for the production of fibre. It must be borne in mind, however, that when the market values of other cordage fibres, such as Manila and Sisal hemps, are low, the fibre of the fruiting banana would only realise very low prices and would not be profitable to extract.

Samples of banana and plantain fibres from various parts of British West Africa have been received at the Imperial Institute, but in most cases have been found to be much inferior to Manila hemp and unlikely to be of value except for local uses.

PLATE III.

FIBRE CULTIVATION IN THE EMPIRE.

FIG 1.—MANILA HEMP PLANTATION, 2 YEARS OLD, AT TAWAN.
Kuhara Estate, British North Borneo.

FIG. 2.—MANILA HEMP.
Stripping the fibre from the leaf stalk, British North Borneo.

PLATE IV.

FIBRE CULTIVATION IN THE EMPIRE

FIG 1 - SISAL HEMP. YOUNG PLANTATION
Government Experimental Farm, Rabai District, Kenya

FIG. 2.—SISAL HEMP. OLDER PLANTS.
Government Experimental Farm, Rabai District, Kenya

In Kenya Colony, there is a kind of banana plant (*Musa Livingstoniana*) which grows wild in several districts and yields a fibre of good quality. Samples of this fibre examined at the Imperial Institute were of satisfactory strength, and were regarded as similar to the superior grades of Manila hemp.

The fibres of two other species, *M. Ensete* and *M. uluguruensis*, which grow in Tanganyika, have also been examined and found to be of very promising character, and equal in value to high-grade Manila hemp.

Sisal Hemp

The well-known cordage fibre, Sisal hemp, is derived from the leaves of certain species of Agave. The name is now usually restricted to the product of *Agave sisalana*, Perr. (*A. rigida*, Miller, var. *sisalana*), although it was first applied to the fibre produced in Yucatan, Mexico, mainly from the leaves of *A. fourcroydes*, Lem. (*A. rigida*, Miller, var. *elongata*, Jacobi). The Mexican fibre is commonly distinguished as " Henequen," or " Mexican Sisal."

The true Sisal hemp plant is a native of Central America, but has been introduced into most tropical countries of both hemispheres.

The development of the sisal-growing industry in the British Empire, which has now assumed very large proportions, is entirely an outcome of enterprise carried out during the present century. An account of the efforts which have been made to establish this industry have already been given in a paper which I prepared for a Conference held in connection with the Sixth International Exhibition of Rubber, Other Tropical Products and Allied Industries, which took place at Brussels, in April, 1924. This paper has been published in full in the BULLETIN OF THE IMPERIAL INSTITUTE (1924, **22**, No. 1). I therefore propose to deal with the subject now in as brief a manner as possible.

Attempts have been made to grow the crop in a large number of British countries, including the following. In Africa: Tanganyika Territory, Kenya Colony, Uganda, Nyasaland, Zanzibar, Mauritius, Nigeria, Sierra Leone, Gold Coast, Union of South Africa, South-West Africa and

Rhodesia; in Asia: India, Ceylon, Federated Malay States and North Borneo; in the West Indies and the American Continent: Bahamas, Jamaica, Cayman Islands, Caicos Islands, Antigua, British Guiana, British Honduras; and in Australasia: Queensland, Northern Territory, Papua, Solomon Islands and Fiji. Reference to the trials made in these countries and an indication of the present position and prospects of the industry in each of them will be found in the paper to which I have alluded. I shall now refer only to areas which are actually producing the fibre in commercial quantities.

Tanganyika Territory.—The Sisal hemp plant was introduced into German East Africa (now Tanganyika) in 1893. In that year the German East Africa Company ordered 1,000 plants from Florida, but only 62 of them survived the journey. These were carefully tended in a plantation at Kikogwe, and new plants were propagated from them so that in 1898 the number had increased to 63,000. In 1899 machinery was introduced for extracting the fibre. By the beginning of 1900, no less than 150,000 plants had been established, of which 4,000 were more than three years old, and were ready for cutting. The first shipment of fibre was made in 1900 and amounted to 7½ tons. From this time forward the industry progressed with remarkable speed, until in 1912 the total area planted with Sisal hemp amounted to 61,162 acres, and, in 1913, 20,835 tons were exported.

The industry was seriously affected by the war, and on the establishment of British administration in 1920 it was found that many of the best plantations had undergone serious deterioration. The situation has been gradually retrieved, and in 1924 and 1925 the exports amounted to 18,428 and 18,276 tons respectively. The area devoted to the crop in 1925 was nearly 109,000 acres, and there is no doubt that the production will continue to increase. Standard grades have now been established, and this policy has facilitated the marketing of the crop by increasing the confidence of importers.

The Sisal hemp produced in Tanganyika is of excellent quality, and realises the highest prices, being usually quoted at about 10 per cent. in advance of Mexican Sisal.

Kenya Colony.—The cultivation of Sisal hemp in British East Africa (now Kenya Colony) was begun in 1903, trials being made first in the Nairobi District and a little later in other parts of the country. Excellent results were secured, and the encouragement thus obtained led to a gradual extension of the industry. It was found that plants grown at the coast yielded a higher percentage of fibre than those grown in the Highlands and also furnished a finer fibre, but that in the Highlands a larger yield per acre was obtained and the cost of labour was less. In 1913 about 7,000 acres had been planted; in 1916–17 there were about 15,000 acres devoted to the crop, whilst in 1925 the area amounted to no less than 52,852 acres. Production of the fibre has increased at a similar rate; the exports increased from 1,073 tons in 1913–14 to 3,421 tons in 1916–17 and 14,363 tons in 1925.

The greater part of the Sisal hemp produced in Kenya is exported to the United Kingdom. Improvements made during recent years in the organisation and management of labour and the increase in the output of the factories have effected considerable economies in the cost of production; and these factors, in conjunction with a lowering of the transport rates, have enabled the industry to be carried on profitably even when the market prices of the fibre are comparatively low. The Department of Agriculture have endeavoured through the London Hemp Association to arrange for the establishment of standard grades acceptable to the market.

There is a vast area of land in Kenya which is well adapted for Sisal hemp growing, and the further expansion of the industry depends chiefly on the introduction of capital and the supply of the necessary labour.

Nyasaland.—Sisal hemp has been found to grow well on loose sandy soils in all parts of Nyasaland, but the cultivation of experimental plots at various altitudes in the Protectorate has shown that the best results are obtainable at elevations not exceeding 2,500 ft. The industry is now being carried on as a commercial enterprise and the outlook is very promising.

In 1925, an area of 4,813 acres was under cultivation, of which 3,693 acres were in the Lower Shire District and

1,113 acres in the Ruo District. The exports of fibre in 1924 and 1925 amounted to 799 tons and 784 tons respectively.

Gold Coast.—An interesting experiment in Sisal growing is now being carried out by the Government of the Gold Coast. During the German occupation of Togoland large plantations of Sisal hemp were created, two of which subsequently came under British administration. These plantations proved so successful that in 1920 it was decided to plant an area of 1,000 acres on a site a few miles west of Accra, with the object of demonstrating that the dry plains at present lying waste in this region can be profitably cultivated. The plantation is intended to serve as the centre of an industry which it is hoped will be adopted by the native farmers as soon as they have appreciated the value of the crop. A central factory has been erected and equipped with modern fibre-extracting machinery. The Government are under agreement with the local chiefs to hand the plantation and machinery over to them when the capital outlay has been recovered and when they have proved themselves competent to carry on the enterprise. In the year 1925–26, 654 acres were harvested, of which 322 acres were cut for the second time, and the production of fibre amounted to 247 tons.

The local farmers are being encouraged to plant Sisal hemp, especially in the neighbourhood of the Government plantation, and advice and assistance are being freely afforded to them. There are many miles of country suitable for the cultivation, and it is hoped that an extensive industry may eventually be created. Meanwhile an offer to purchase the Government plantation has been received from private enterprise on condition that a lease of about 4,000 acres of land can be obtained in the neighbourhood of the present mill, and the offer has been referred to the Chiefs owning the land for consideration. It is understood that negotiations are still in progress.

Ceylon.—Sisal hemp was grown for several years by the Department of Agriculture of Ceylon at the Maha Iluppallama Experiment Station in the North-Central Province and satisfactory results were obtained. In 1918

this Station was closed, but with a view to continuing the experiments and extending the cultivation a syndicate was formed which was granted a concession of 2,200 acres of Crown Lands on special terms. Work was started in 1919 and good progress has been made. There are good grounds for anticipating that the enterprise will be fully successful and, if such should be the case, it is probable that the industry will undergo great expansion, as there are vast areas available in the dry zone of the Colony which are at present uncultivated and would be quite suitable for Sisal hemp.

Since 1918 the Agricultural Department has had areas of Sisal under cultivation at Anuradhapura, also in the North-Central Province, where a small mill has been established for extracting the fibre. The Department is also undertaking small experimental trials at Jaffna and Hambantota, in the extreme north and extreme south of the island respectively.

In 1925 a quantity of 171 tons of Sisal hemp was exported from Ceylon.

Bahamas.—The Sisal hemp plant has long been acclimatised in the Bahamas, but was not seriously regarded as worthy of systematic cultivation until 1888, when the Governor of the Islands (Sir Ambrose Shea) took steps to encourage the establishment of a local fibre industry. During the next few years several large undertakings purchased extensive tracts of land and planted them with the Sisal agave. The industry developed very rapidly, the maximum exports being reached in 1916, when 3,739 tons were shipped. The exports during recent years have amounted to between 1,000 and 2,000 tons per annum. Nearly the whole of the fibre exported from the Bahamas enters the United States.

The production of Sisal hemp has proved of much value to the Bahamas, and, owing to the resistance of the crop to drought, it has been of great financial assistance to the people at times when other crops have failed.

Jamaica.—In 1917, the Jamaica Government commenced an attempt to develop Sisal cultivation in the island. A Sisal plantation was established at Lititz on land which was regarded as useless for other crops, and a

factory was erected at the northern extremity of the plantation, so that the adjacent lands which are in private possession might be planted with Sisal hemp and the leaves sold to the factory on a co-operative basis.

In 1922 there were 1,141 acres devoted to the crop at Lititz. The factory, which is equipped with English machinery, commenced operations in that year and 50 tons of the fibre produced were sold at satisfactory prices. In 1925, 113 tons were extracted. There is no doubt that the savannah lands of Lititz are capable of yielding excellent fibre. The new industry has been of great advantage to the people of Lititz, many of whom would otherwise have suffered severe privations during periods of drought.

Mauritius Hemp

The Mauritius hemp plant, *Furcræa gigantea,* is a member of the same natural order as the agaves, viz. Amaryllidaceæ. It occurs widely in tropical America, and has been introduced into India, Ceylon, Natal, Nyasaland, Kenya Colony, Uganda, Rhodesia, West Africa, Mauritius, St. Helena, the West Indies, Australia, Fiji, and other countries.

The fibre is produced in commercial quantities chiefly in the island of Mauritius, although there is no doubt that it could be readily grown in many other countries.

Mauritius.—The plant is known in Mauritius as "aloes," and is said to have been first introduced into the island from South America about the year 1790 as an ornamental garden plant. In 1837 it had established itself in several parts of the island, and, although receiving no attention, it gradually spread over waste lands and abandoned sugar estates, until in 1872 the plants were so abundant as to suggest their utilisation for the extraction of fibre. An industry was started about the year 1875, and has continued up to the present time. The plant now grows wild in all parts of the island, and is estimated to occupy an area of about 20,000 acres.

A Committee which was appointed in 1924 to consider methods for improving the industry recommended that the fibre growers should form an organisation to co-operate in the handling, grading and marketing of the crop, and

that standard grades for Mauritius hemp should be established. The Government has made an advance towards the cost of erecting a central grading and baling establishment, and the Director of Agriculture has entered into negotiations with buyers with a view to establishing standard grades.

In cultivating the crop in Mauritius, little attention is paid to it, after it has once been planted, beyond the harvesting of the leaves. When prices are satisfactory, and other conditions are favourable, the produce is reaped, but otherwise the plantation is left uncut. This system accounts for the fact that the exports of fibre vary greatly from year to year. The exports during the decade 1916–1925 ranged from about 300 tons in 1921 to 2,500 tons in 1919, the average annual exports being about 1,200 tons.

Union of South Africa.—About forty years ago, *Furcræa gigantea* was introduced into Natal, and has since spread along the coast lands. A serious attempt was made about twenty years ago to cultivate the plant in the vicinity of Port Shepstone. Plantations were established, encouragement was given to the settlers to plant small areas with the crop, and a mill was erected and equipped with the needful machinery. The plantations were afterwards neglected, but were reclaimed in 1906, and modern machinery was installed. There are now about 1,000 acres devoted to the crop, and from 200 to 300 tons are produced annually and are used by manufacturers in South Africa. It is considered that the industry is capable of development.

Nyasaland.—The Mauritius hemp plant grows well in Nyasaland, and produces fibre of excellent quality throughout the Protectorate up to elevations of 2,900 feet. Some years ago plantations were established in the Blantyre district, and small quantities of fibre were produced for export.

New Zealand Hemp

New Zealand hemp is obtained from the leaves of *Phormium tenax*, a member of the natural order Liliaceæ. The plant was discovered by Captain Cook during his voyage to the South Seas in 1768–1771, and it was introduced by him to the notice of Europeans. He stated that

it produced a fine, silky fibre, of which the natives made their garments. The plant is indigenous to New Zealand, where it covers large areas, and it is also found in Norfolk Island and other parts of Australasia. It has been distributed to many other British countries, including St. Helena, Natal and South India. It has also been introduced into the south of Ireland, and is found in several parts of Great Britain from the south-west coast of Scotland to Cornwall. It is planted in the Scilly Isles in order to resist encroachments of the sea, and has been cultivated in the Orkney Islands.

The commercial supply of the fibre is at present derived entirely from New Zealand with the exception of small quantities produced in St. Helena.

New Zealand.—A fairly considerable trade in Phormium fibre existed in New Zealand in the early years of the last century. In 1828 the exports amounted to 60 tons, in 1830 to 841 tons, and in 1831 to 1,062 tons. A factory for the manufacture of cordage from New Zealand hemp was established at Grimsby in 1832, but failed for some unexplained cause, although the results were regarded as satisfactory.

Small quantities of the fibre extracted entirely by hand continued to be exported. In 1860, the Waikato and other interior districts being affected by native disturbances, the production of the fibre was confined to the tribes north of Auckland and the exports fell to 2 tons. Attempts were then made to devise machinery by means of which the fibre could be profitably extracted by European labour. About this time an increased demand arose for white ropes and an insufficient supply of Manila hemp was available. This led to a rise in the value of New Zealand hemp, and the high prices obtainable stimulated the efforts to invent suitable machinery for its preparation from the green leaf. Several machines were invented, and the export trade increased considerably, the aggregate exports between 1864 and 1876 amounting to 26,434 tons.

In order to encourage the industry, the New Zealand Department of Agriculture has repeatedly offered bonuses for a machine or process which should be an improvement on the machines or processes in use, and which should

be found to reduce materially the cost of production, improve the product, or increase the yield of dressed fibre. Another bonus has been offered for a process for utilising the waste products of the hemp. As a result of these offers, improvement has been effected in various machines, including those for converting scutching waste into marketable tow and those for washing and trimming the fibre.

Owing to the complaints of rope and cordage manufacturers with regard to the lack of uniformity in New Zealand hemp, parcels bought under the same classification and shipped from the same port varying in colour and preparation, the Government passed an Act in 1901 providing for the establishment of a grading station for the compulsory grading of all hemp exported. As a result of this, the quality of the fibre rapidly improved, and the confidence of buyers was secured. This grading system was afterwards extended to tow and is still enforced.

During the five years 1916–1920, the average annual exports from New Zealand amounted to about 23,500 tons of fibre and 3,000 tons of tow, but in 1921 the exports suddenly fell to 9,643 tons of fibre and 1,534 tons of tow. This reduction was largely due to the ravages of the yellow leaf disease which in 1920 led to the abandonment of 5,000 acres of Phormium swamp. An improvement has since taken place and the exports have gradually increased until in 1925 they amounted to 16,408 tons of fibre and 3,515 tons of tow. The yellow leaf disease has now largely disappeared.

St. Helena.—Phormium tenax has been planted somewhat largely in St. Helena and was successfully cultivated during the years 1876–1880, 615 bales being shipped in 1879. A factory was established for extracting the fibre, but as this was several miles distant from the plantations the cost of transport absorbed all the profit. An attempt was made in 1905 to revive the industry, but this did not meet with much success, owing partly to the difficulty of raising the necessary capital and partly to the fact that the machinery purchased was not altogether satisfactory. Later, however, a further endeavour was made with Government assistance, and under the guidance of

an expert from New Zealand. A fibre mill was established by the Government in 1908 and has since been regularly employed in extracting the fibre. Other mills have been erected by private enterprise and there are now six mills in operation, employing some 300 persons, about one-tenth of the total population of the island. In 1924, the Government flax mill was transferred to a London company, known as the St. Helena Corporation, Ltd. The exports in 1925 amounted to the record quantity of 943 tons of fibre and 420 tons of tow. A factory for the manufacture of cordage was started a few years ago, and in 1924 rope, cord and twine were exported to the total amount of 32 tons.

South Africa.—It has been recently reported that *Phormium tenax* is being planted on the borders of the Newcastle Town Lands in Northern Natal, and it is proposed to devote between 2,000 and 3,000 acres to the crop. The suckers for planting have been obtained from St. Helena, and the planting is being done under the supervision of a Government expert from that Island. It will be three years before the plants are ready for cutting.

British Isles.—It has been stated by the authorities of Kew Gardens that the most likely places in the British Isles in which New Zealand hemp might be expected to succeed are Cornwall and parts of Devon, the West of Scotland and the South, South-West and North-West of Ireland. A few years ago the plant was cultivated on a fairly large scale in the South-West of Scotland with very promising results. It was also extensively planted in Ireland in Co. Kerry, and the trials indicated that the crop could be successfully grown on commercial lines. In neither case, however, have the experiments led to the establishment of a commercial industry.

Bowstring Hemp

There are numerous species of Sansevieria (natural order, Liliaceæ), the leaves of which yield fibre suitable for use in cordage manufacture and known as "bowstring hemp." These plants are abundant in tropical Africa, and also occur in Ceylon, India, the Dutch East Indies and China. The fibres resemble Sisal hemp in genera pro-

perties, but there is much diversity of character between the products derived from different species.

Several species grow wild over extensive areas of Kenya Colony, and in 1905 the extraction of fibre, chiefly of *S. Ehrenbergii*, was undertaken in the neighbourhood of Voi and considerable quantities were exported. Subsequently, however, the preparation of this fibre declined, attention being transferred to the cultivation of Sisal hemp.

The fibre of *Sansevieria Ehrenbergii* is extracted by the natives of Somaliland, who use it for making their camel ropes. The plant grows wild in considerable abundance in that country, and in 1907 a London company was formed to prepare the fibre by machinery. After a good deal of trouble in obtaining suitable machinery for the work, the Company was just in a position to commence operations on a commercial scale when, owing to trouble in the interior, they had to return to the coast and abandon all their material.

Other Leaf Fibres

In concluding this survey of the leaf fibres, reference must be made to certain fine, strong fibres which have not hitherto been prepared on a commercial scale in any country of the British Empire. Such are the fibres of the leaves of the pineapple and other plants of the natural order Bromeliaceæ, and of certain palms, especially the African oil-palm.

Pineapple fibre is a fine, strong, white lustrous material, which would probably serve as a substitute for flax. It is extracted by hand by the natives of the Philippine Islands and Formosa. In the Philippines the natives make beautiful silky fabrics which find a local market. The fibre produced in Formosa is exported to China, where it is employed for the manufacture of fabrics of peculiarly fine texture. The preparation of the fibre by hand is a tedious operation, and is only possible in countries provided with very cheap labour.

The leaves of several other plants of the pineapple family (or Bromeliaceæ) yield similar, fine, strong fibres. Among these may be mentioned the "Crowa" fibre of the West Indies and British Guiana, and the "silk grass"

of British Honduras. The latter is stated to be identical with the so-called "Arghan" fibre, the cultivation of which was commenced in the Federated Malay States a few years ago.

The leaflets of the West African oil-palm (*Elæis guineensis*) yield a fine fibre of great strength and excellent quality which is used by the natives of West Africa for making fishing lines and fine cordage. Small quantities of this fibre have appeared from time to time on the market, but the cost of production by hand is so great as to make it impossible to prepare it at any but a prohibitive price, even with the advantage of native labour.

It is evident that these fibres cannot become available for export until they can be produced on a commercial scale by a much more rapid process than native hand-labour. They are all fibres of excellent character, and would undoubtedly meet with a ready demand if they were marketed in large quantities at reasonable prices. There is therefore an opportunity for some inventive genius to devise a suitable process or a satisfactory machine for their extraction. The problem is doubtless a difficult one, but its solution would be amply repaid.

NOTES

Imperial Institute Public Exhibition Galleries.—These galleries were re-opened in September 1926 after undergoing redecoration and a complete re-arrangement of the exhibits. They now provide under one roof an attractive exhibition illustrative of the resources of all the countries of the Empire. For many of the overseas countries these galleries are the only exhibition in the home country where there is a permanent display of their products and resources for the information of the general public. With a view to making them of value to teachers of Empire geography the exhibits have been specially arranged to attract children and non-technical visitors. A special feature is made of illuminated dioramas, models and photographs, which serve to illustrate the samples of raw products which are exhibited in association with them. Since the re-opening of the galleries fifteen new dioramas have been constructed in the Institute studios and placed

on exhibition, and six others have been planned and are in course of construction. For providing the funds for some of these dioramas the Institute is indebted to private firms and associations; others have been obtained out of special grants from the Governments of the countries concerned. The most recent additions are two dioramas illustrating the rubber industry in Malaya, which were obtained from funds granted by the Rubber Growers' Association; and one illustrating the copra industry in the Solomon Islands, for which the Institute is indebted to the generosity of Messrs. Lever Brothers.

Two Guide Lecturers are maintained at the Institute to conduct parties from schools. These parties are of two kinds, (1) consisting of school teachers who make a preliminary tour with the Guide Lecturer and afterwards bring their pupils, and (2) pupils from schools accompanied by their teachers. The conducted tours are made by previous arrangement with the Secretary in writing, but the galleries are also available to teachers and school parties at all times without formality of any kind.

At the Central Stand in the galleries enquiries are received and referred to the appropriate department, free literature relating to Empire countries and products is distributed, and priced publications and picture postcards are on sale. A new series of postcards illustrating important Empire products has just been commenced. The subjects will be added to from time to time as the demand increases.

The galleries are open free daily from 10 a.m. to 5 p.m. (Sundays 2.30 p.m. to 6 p.m.).

Cinema.—An existing building connected with the Public Exhibition Galleries has been adapted as an up-to-date picture theatre out of funds provided by the Empire Marketing Board. It is proposed to open this cinema in June, when the Delegates to the Imperial Education Conference are in London, for the display of films illustrating life and industries in the home country and in the overseas countries of the Empire. Excellent films have already been secured from the representatives of the Dominions governments in London and from various important associations and firms, and it is anticipated that this innovation will not only form an attractive feature of general interest but also one of great educational value.

Imperial Gallery of Art.—The Upper East Gallery has been re-decorated and fitted as an Art Gallery for the

exhibition of the work of selected artists from all parts of the Empire. The first exhibition of this kind opened in April last. The gallery is also used for judging and exhibiting the work of candidates for the School of Rome scholarships and for the exhibition of work by School of Rome students.

Colonial Office Conference.—The Director and representatives from the Imperial Institute attended the recent Conference at the Colonial Office when such questions as the exchange of information, agriculture and research work, forestry, cinema films, and the existing and proposed Colonial agencies in London were discussed.

School Empire Tour Committee.—At the request of the Dominions Office accommodation has been provided at the Imperial Institute for the Committee which is concerned with the arrangements for visits to the Dominions of selected scholars from schools in the home country.

Ceylon Rubber Research Scheme.—The annual general meeting of subscribers to the Scheme (see this BULLETIN, 1925, **23**, v) was held at Colombo, Ceylon, on April 12, 1927. The detailed reports on the work in Ceylon and London, a summary of which is given in the following pages, show that during 1926 the Scheme continued to make steady progress. As in 1924–25, grants of Rs. 67,500 and £2,000 were made by the Ceylon Government and the Rubber Growers' Association respectively. The receipts from local subscribers in the Colony amounted to Rs.31,600 as compared with Rs.24,706 in 1925.

Visits were paid by the Organising Secretary to sixty-five estates during the year and reports made thereon to the agents and superintendents. Further improvements in the general conditions of estates in Ceylon were observed, but there are indications that "brown bast" is again on the increase, particularly in the drier districts of the Island, and a large percentage of cases has been observed on some estates. Many of the difficulties connected with diagnosis have been overcome and good results are being obtained by the treatment advised.

A high standard of manufacture was reached and remarkably few complaints were received during the year. Paranitrophenol proved entirely satisfactory in eliminating mould and experiments show that it can now be used to clean up sheet which has already become mouldy. A definite recommendation to use it was accordingly issued to subscribers. "Rust" on sheet rubber is now one of the rarest occurrences in Ceylon factories.

The manuring of rubber is claiming considerable attention owing to the need for improving the condition of the majority of Ceylon estates. Numerous carefully devised manurial experiments have been carried out and although they have given no indication of improved yields, there is good reason to believe that an improvement in the general condition of the trees has resulted. Further experiments are in progress. The value of cover crops as a means of preventing soil erosion and for the purpose of improving the general condition of the soil is now generally recognised. Excellent covers of *Vigna oligosperma* have been established on many estates and *Tephrosia candida* continues to give satisfactory results.

The Physiological Botanist is in charge of the Research Scheme Experimental Station which is being developed at Nivitigalakele, where he is giving special attention to problems relating to budding. Following on the visit of a member of the Executive Committee of the Scheme to the Dutch East Indies there has been a strong revival of interest in this subject, and the number of trees in Ceylon whose yield record is known has increased considerably during 1926. The interest in budding as a means of producing better trees has also greatly increased and most estates with any reserve of land are making arrangements to have new clearings budded. Instruction and information have been given by the Physiological Botanist to a large number of applicants on all questions relating to this subject. During the year he completed his study of the relationship between the yield of latex and the botanical characters of the tree, and the results, which were published in the *Research Scheme Bulletin No.* 43, show (1) that yield is an inherent quality of the tree, (2) that a latex vessel row count is of more value in connection with "thinning out" operations with old trees than with very young ones, and (3) that girth and cortex thickness are intimately related.

The Mycologist visited Southern India during March to obtain first-hand information on the practice of spraying rubber, and on his return carried out a series of demonstrations in various districts, which were largely attended by planters. Several estates have sprayed small areas, but the results have not been very satisfactory and it is hoped to make further trials in 1927 with apparatus of a different pattern. Experiments which were started in 1925 to test the efficiency of various disinfectants for bark rot were continued, and while no final conclusions can yet be framed there are indications that disinfectants incorporated into a non-soluble base are likely to prove

more satisfactory than the water-soluble disinfectants. Observations on the effect of pollarding rubber trees indicate that it is of no value against the attack of secondary leaf fall, and is attended by such other unsatisfactory results that the practice is not to be recommended. The Mycologist resigned his appointment in September, and considerable difficulty has since been experienced in obtaining a suitable successor.

The Chemist completed his investigations on the effect of different conditions of smoking, and experiments are now in progress with a view to securing appreciable economy in fuel consumption and possibly eliminating fire-wood as a heating medium in smokehouses. Tests were also carried out to determine if the contamination of latex with Bordeaux Mixture would prove detrimental to the rubber: it was found that the addition of very small amounts of copper leads to deterioration, and it is therefore urged that extreme care should be taken to ensure that all copper compounds and mixtures are kept away from factories and that no utensil used in the making or transport of Bordeaux Mixture should be used for the collection of latex. The Chemist proceeded on home leave during the year and whilst in England paid visits to various rubber manufacturing works and to the laboratories of research institutions.

The principal problems dealt with in London were the variations in the plasticity of raw, masticated and mixed rubbers, and the effects of methods of preparation on the deterioration which occurs in the physical properties of vulcanised rubber on ageing.

Since 1925 considerable progress has been made in connection with both these subjects. The preliminary investigations to establish suitable methods of testing which had been in progress for some time were completed, and standardised plasticity and "artificial ageing" tests are now made wherever possible on all samples received for report on their quality.

In connection with the work on plasticity it was found that unsmoked sheet was less plastic than smoked sheet, that the temperature of drying was important and that different smokehouses yielded rubber with different plasticities. The products of different estates showed marked variation, and it is accordingly proposed to devote special attention in 1927 to a study of the cause of this inequality.

The principal conclusion drawn in the report from the work on ageing is that rubbers which retain the most serum substances give the best results as regards the development and maintenance of tensile strength on ageing in

a rubber-sulphur mixing. On the other hand these rubbers show the greatest decrease in stretch under load. Having regard to these striking differences a similar investigation in a number of technical mixings is proposed.

The results obtained with different forms of rubber suggested that the non-caoutchouc substances present are of importance in connection with ageing, and an extensive series of investigations is accordingly being carried out with (*a*) dry serum from preserved latex, and (*b*) the acetone extracts of different forms of rubber. Considerable progress has already been made and it has been found that the ageing properties are markedly affected by changes in the non-caoutchouc constituents. There appears to be an "anti-oxidant" present in the non-saponifiable portion of the acetone extract and also in the serum. The "anti-oxidant" in the serum is almost ineffective in the absence of the acetone-soluble constituents, but is very powerful in their presence. The whole of the results were reviewed in a paper read before the London and Birmingham Sections of the Institution of the Rubber Industry in January 1927, and published in the *Transactions* of the Institution (February, 1927, page 354). As in previous years tests were also made on a number of samples received in connection with the investigations carried out by the technical staff in Ceylon.

Other questions which were dealt with during the year included the effect of the extraction of rubber with ammonia, the effect of low temperature on the physical properties of raw rubber, and the behaviour of Hopkinson-sprayed latex rubber in plasticity and ageing tests.

Kudzu as a Fodder Plant.—Attention has been devoted in recent years to the possibility of growing the leguminous plant, kudzu (*Pueraria Thunbergiana*), as a fodder crop, particularly in countries subject to a long dry period. Kudzu is a somewhat woody perennial climber with large leaves, resembling those of the common bean. It is a native of Japan, where it is largely grown as a forage plant on steep slopes and other untillable land. The vine was introduced into the United States many years ago and was grown as an ornamental climber, and only comparatively recently has it been cultivated in the Eastern States for livestock feeding. It has also been introduced for the latter purpose into Southern Rhodesia, the Union of South Africa and Australia.

The plant succeeds in various types of soil, but usually grows better in those of a clayey nature than in sandy soils. It can withstand slight frost, and in Rhodesia has

been found to make strong new shoots quickly in early spring as soon as the temperature rises. When well established kudzu grows very rapidly, and under favourable conditions of temperature and moisture the branches reach a length of from 10 to 20 ft. in a single season.

Difficulty has been experienced in germinating the seeds of kudzu, and fields are usually planted with well-rooted plants raised in a nursery from cuttings or from layers. The plants are set about 10 ft. apart each way in the field. During the first season the trailing runners cover the ground; good crops are secured in the second season, but the full crop is not usually obtained until the third season.

Kudzu may be utilised as pasture for cattle, but should not be grazed too heavily. Some farmers in the United States allow the crop to grow until the dry season when other pasturage is likely to be scanty. It is recorded that during an extremely dry period the only green forage available at the Louisiana Agricultural Experiment Station was furnished by kudzu. Experience in Queensland has also demonstrated its value during the dry season. A Queensland farmer has stated (*Queensland Agric. Journ.*, 1922, **18**, 365) that although there had been little beneficial rain for over seven months, the kudzu vines on his farm were a mass of succulent dark green leaves, and the runners continued to grow at the rate of several inches a day. He further states that during a very dry winter the kudzu was eaten down several times by sheep, and on each occasion, despite the absence of rain, the plants began to send out fresh shoots as soon as the animals were removed. In Rhodesia also, kudzu has proved to withstand drought well.

With regard to the amount of fodder yielded by kudzu, it is recorded that a plot in Rhodesia, which was irrigated once in August, gave, from four cuttings between September 30 and May 24, 15½ tons of green fodder per acre, whilst an adjacent plot of lucerne, irrigated three times, gave 3⅓ tons from five cuttings between October 24 and April 3.

Kudzu is also suitable for hay, and it is stated that in northern Florida three cuttings have been obtained in a season from well-established fields, and yields as high as 10 tons per acre have been recorded.

According to the Department of Agriculture, Rhodesia, kudzu, both in the green state and as hay, is palatable and wholesome, and is greatly relished and easily digested by all classes of stock. Chemical analyses of kudzu grown in the United States and in Rhodesia indicate that

in composition the plant is comparable with clover and lucerne. The composition of the Rhodesian grown plant, compared with lucerne, cowpea and velvet bean hay, as recorded by H. G. Mundy (see reference below), is as follows:

—	Kudzu.		Lucerne hay.	Cowpea hay.	Velvet bean hay.
	Sample as taken.	Air-dried.			
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Water	80·97	9·24	8·0	8·2	9·3
Fat	0·38	1·84	2·3	2·4	2·6
Protein	3·42	16·30	15·5	13·2	13·3
Carbohydrates	6·53	31·10	30·5	39·4	39·4
Fibre	6·68	31·87	34·8	30·5	27·6
Ash	2·02	9·65	8·9	6·3	7·8

Further particulars regarding kudzu will be found in the following publications:

"Kudzu." By C. V. Piper. *Department Circular* 89, *United States Department of Agriculture* (Washington: Government Printing Office, 1920).

"Kudzu Vine." By H. G. Mundy. *Rhodesia Agricultural Journal,* February, 1921, Vol. xviii, No. 1, pp. 83–88.

"Propagation of Kudzu Vine." By H. C. Arnold. *Rhodesia Agricultural Journal,* August, 1922, Vol. xix, No. 4, pp. 435–438.

Sub-Tropical Agriculture in South Africa. By H. G. Mundy. (Salisbury, Rhodesia: Argus Printing & Publishing Company, Ltd., 1923.) Pp. 245–251.

Banana Cultivation in Hawaii.—W. T. Pope, Horticulturist to the Hawaii Agricultural Experiment Station, has recently published as *Bulletin No.* 55 of that Station, an interesting account of banana culture with special reference to Hawaii. The *Bulletin* is mainly concerned with a general account of the banana, including the botanical characters of the plant, the composition and food value of the fruit, the propagation and cultural requirements of the crop, methods of harvesting and shipping, pests and diseases, and a description of the different varieties, both local and introduced, which are found in the Islands. The following particulars relating to the industry in Hawaii, which have been extracted from Mr. Pope's account, will be of interest in connection with articles on the banana, previously published in this BULLETIN ("The Banana and its Cultivation, with Special Reference to the British Empire," 1924, **22**, 303, and "Banana Cultivation in the Canary Islands," 1925, **23**, 168).

The banana is comparatively easy to cultivate in Hawaii, few insect pests and diseases are prevalent and the plant is seldom damaged by the wind. The Agricultural Experiment Station at Honolulu has therefore paid special attention to increasing its cultivation, and banana production now ranks third in importance of the local industries. The exports at present amount to about 200,000–250,000 bunches annually.

A number of varieties of banana are found in a semi-wild or cultivated condition in the Hawaiian Islands and, as similar varieties are found in other islands of the tropical Pacific, it is presumed that the plants were dispersed among these islands by the Polynesians in the course of their migrations. Since the Hawaiian islands became known to Europeans through their discovery by Capt. Cook in 1778, varieties well known in other countries have been introduced. One of the earliest of these was the Cavendish or Chinese banana (*Musa Cavendishii*), the form grown in the Canary Islands. This came from Tahiti in 1855, and is now the leading commercial variety in the islands, its adaptability to local conditions placing it in the first rank among the many banana varieties so far cultivated. Other well-known introduced forms which are now grown to a greater or less extent include "Gros Michel" (one of the most important of the West Indian varieties), "Red," and "Lady Finger."

The Hawaiian varieties are practically all of the starchy plantain-like kind and are most palatable when they are cooked. Most of them fall into three groups: (1) "Maoli," large plants bearing large compact bunches of long fruits well filled to the tip; these fruits have a thick heavy skin of a rich yellow colour when ripe and a yellow flesh. (2) "Iholena," erect plants with long arched fruiting stems, bearing small or medium-sized bunches of angular, tapering fruits which stand out nearly at right angles to the stem; the skin is thick and yellow at maturity and the flesh of a light pinkish-salmon colour. (3) "Popoulu," plants of medium height bearing compact bunches of short thick fruits, without angles, set at right angles to the stem; the skin is very thin, yellow when ripe, and the flesh is a light salmon colour.

The commercial varieties are grown mostly at the lower elevations, whilst the local forms are planted by the natives in the higher mountain gorges where moisture is abundant. Forest soils at elevations of 1,000 ft. or more produce commercial bananas of excellent quality, but the crop takes longer to mature there than on the low-lying lands. In the latter zone irrigation is often

necessary, but at higher situations the natural rainfall is usually sufficient, so that the cost of production is thereby reduced.

The bunches intended for export are washed to remove dust, trash and insects, and after drying are inspected in accordance with the plant quarantine regulations of the United States Department of Agriculture. They are then wrapped separately in a protective covering consisting of paper, rice straw and banana leaves. At present steamers fitted with cooling apparatus are not available for the shipment of bananas from Hawaii and they have to be shipped as deck freight, which is not always a satisfactory method.

As already indicated, the banana is subject to the attack of few insect pests or fungoid diseases in Hawaii. The Japanese beetle (*Adoretus umbrosus*) is occasionally found feeding on the foliage. The cane borer (*Sphenophorus obscurus*) is no longer a pest of the banana plant in Hawaii, having been almost completely exterminated by the tachinid fly, *Ceromasia sphenophori*, which was introduced into the islands in 1910 to check its ravages.

A mealy bug (*Pseudococcus bromeliæ*) is found in masses between the fruits in some localities during the drier months of the year and although it does not seriously retard development of the fruit it makes it unclean. It is removed from the severed bunches by washing them with streams of water from a force pump. The pest also attacks young suckers and sometimes injures them considerably, but may be controlled by spraying with an oil emulsion.

Although the Mediterranean fruit fly (*Ceratitis capitata*) is well established in Hawaii, it has so far never been found on commercial bananas.

The most serious fungus disease in Hawaii is the freckle disease (*Phoma musæ*), which attacks almost exclusively the Chinese banana. Most damage is caused during the months of greatest moisture. The fungus commences its growth on the foliage and the spores formed there fall on the developing fruits and cause the skin to blacken in specks or freckles. The spotted appearance of the skin, which becomes more evident as the fruit ripens and attains full colour, greatly depreciates the value of the fruit. The disease is largely controlled by spraying with Bordeaux mixture and by wrapping the bunch of fruit in paper, several weeks before it reaches full size, so as to prevent spores alighting on it.

ABSTRACTS OF RECENTLY PUBLISHED LITERATURE ON AGRICULTURE AND FORESTRY

In this section a summary is given of the contents of the more important, recently published papers and reports relating to tropical agriculture and forestry. It must be understood that the Imperial Institute accepts no responsibility for the opinions expressed in the papers and reports summarised.

FOODSTUFFS AND FODDERS

The Preservation of Fruit in Artificial Atmospheres.—The importance of preserving fruit and other vegetable food products in a fresh state as a factor in their economic distribution and marketing, and the limitations of refrigeration for this purpose, have rendered desirable a study of other means of increasing the storage life of such produce.

The retardation of senescence in living plant products by altering the composition of their surrounding atmosphere formed the starting point of an investigation by the Department of Scientific and Industrial Research into the possibilities of extending the storage life of fruit by the same means. This investigation, begun in 1918, has now reached a stage at which the results so far obtained can be usefully published, and an account of these results is to be found in *Food Investigation Special Report No.* 30, 1927, issued by the Department under the title "Gas Storage of Fruit."

Preliminary laboratory experiments were made with several kinds of fruit, but subsequent storage trials were carried out exclusively with certain varieties of apple. It was found that the replacement of part of the oxygen in the air of a storage chamber by carbon dioxide had a marked retarding effect on the change in colour of apples and on the other changes associated with the process of "ripening," and increased their storage life. It was further found that in series of comparative experiments when the substitution of carbon dioxide for oxygen was carried out progressively the degree of retardation increased, but that after a certain point undesirable results became noticeable, such as a tendency to "brown heart."

The control of the composition of the atmosphere in storage chambers was effected by regulating the degree of ventilation, the conversion of oxygen into carbon dioxide being brought about by the ordinary respiration of the fruit. Generally speaking the best results were obtained

when the proportion of carbon dioxide in the atmosphere was maintained at about 10 per cent., the oxygen being reduced correspondingly, i.e. to about 11 per cent.

Another factor which was investigated was that of temperature. It was found that a rise in temperature had a counteracting effect upon the retardation produced by the artificial atmosphere, and that therefore the self-heating of the fruit when kept in a closed space became a matter of importance. On the other hand the effectiveness of the method was reduced at low temperatures owing to a tendency to "internal breakdown" in the fruit. A series of trials indicated that gas storage, controlled by the method of restricted ventilation to maintain 10 per cent. of carbon dioxide, is most effective at mean temperatures of about 50° F.

The method of controlling the composition of the atmosphere by restricting ventilation, although simple to operate, is not free from objection. Notably, it results in a very high humidity of the atmosphere with the attendant risk of condensation of moisture on the fruit; and, further, the air is stagnant with the consequence that any volatile organic products that may be given off by the fruit accumulate. These two causes together have been found to favour the production of "superficial scald," a disease to which apples in storage are known to be prone.

Though it was found that these harmful effects could be very largely prevented, in the case of apples, by wrapping in oiled paper, the desirability of controlling the humidity of the atmosphere and of avoiding stagnation is evident. It is also pointed out that a method of creating an artificial atmosphere in which the concentrations of the oxygen and carbon dioxide could be independently controlled is a desideratum. These matters, it is indicated, are to form the subject of further investigation.

The Shot-Hole Borer of Tea.—During the last ten years the shot-hole borer (*Xyleborus fornicatus*) has been the subject of almost continuous study in Ceylon, where it is widely distributed throughout most of the tea-growing areas. A further contribution to our knowledge of this pest is published as *Bull. No.* 78 (1926), *Dept. Agric. Ceylon*, entitled "Manuring in Relation to the Control of Shot-Hole Borer of Tea." This contains a review of the subject and reference to the earlier experiments, and records the results of further extensive investigations which have been carried out to ascertain the relative values of nitrogen, potash, phosphoric acid

and lime in the control of the pest. The application of nitrogenous manures, phosphatic manures and lime to the plots had no direct effect on the beetles. The galleries in the treated plots had as many occupants as those in the untreated, and there was not a larger ratio of empty galleries in the treated than in the control plots. The main benefit of the application of artificial manures was found to be in the accelerated healing of the galleries, the most marked effects being observed in plots treated with nitrogenous manures. The healing in the latter plots was completed 2·9 months after the commencement of the formation of the galleries, whereas in the control plots the healing required 3·75 months for completion. The attack was slightly less in the potash and lime plots than in the others, and it is considered that if any soil nutrient helps to ward off an attack by the beetle, the results indicate potash as the most likely. Lime acts similarly to potash owing to its property of liberating potash in the soil.

Burma Beans.—"The Selection of Burma Beans (*Phaseolus lunatus*) for Low Prussic Acid Content," by J. Charlton, in *Memoirs Dept. Agric. India* (*Chemical Series*), Vol. ix, No. 1 (Nov. 1926), records the results of attempts to reduce the prussic acid content of Burma beans by plant selection, and the results of several other investigations bearing on the amount of prussic acid present.

The author has found that no single method of estimation gives the actual total content of prussic acid, the maximum yield being obtained by the action of malt on the beans and this is referred to for convenience as "total" prussic acid. After the action of malt the beans yield a further small amount of prussic acid when they are extracted with hot water and the extract is submitted to acid hydrolysis.

Under ordinary field conditions the influence of environmental factors was found to be more powerful than was rigorous single plant selection, and after four years of single plant selection the prussic acid content had not been reduced. The effect of storage was investigated, and it was found that the amount of prussic acid in Burma beans may vary during storage within wide limits. The results obtained during storage for three years showed the prussic acid at certain periods to be about 50 per cent. higher than at the commencement, and at other times to have decreased to half the original amount. It is concluded that synthesis of prussic acid occurs during

the hot, wet season, while its destruction takes place during the subsequent cold weather. Manurial and soil experiments were conducted, and showed that fairly heavy liming of the soil does not sensibly affect the prussic acid content of the beans. Small variations in soil do not materially affect the content; seasonal variations considerably outweigh other causes of variation.

Oils and Oil-seeds

Aouara.—" Aouara " is the name applied by the natives of French Guiana to the palm, *Astrocaryum aculeatum*, Mey., which is the " Tucum " of Brazil or " Tucuma " of British Guiana. The question of the commercial exploitation of the fruits of this palm growing in French Guiana is discussed in *Bull. Ag. Gén. Col.* (1926, **19**, 1180; 1927, **20**, 73). After a botanical description of the tree and its fruits, the results of an examination of the fruits and kernels are given. The fruits had the following composition: pericarp 23·3 per cent., shell 52·5 per cent., and kernel 24·2 per cent. The pericarp, containing 9·3 per cent. of moisture, yielded on extraction 34·38 per cent. of a brown, semi-solid oil, melting at 22–23° C. and having a specific gravity at 19° C. of 0·887 and a saponification value of 184. The oil-free pericarp residue contained 9·75 per cent. of protein (calculated on the moisture-free material). The kernels (moisture 3·8 per cent.) contained 24·5 per cent. of a solid fat, white to creamy-white in colour. The fat had the following constants: m.p., 32° C.; acid value, 1·18; saponification value, 211–214; iodine value, 9·56–10·0 per cent.; unsaponifiable matter, 0·6 per cent.; Reichert-Meissl value, 0·6; specific gravity at 17° C., 0·915. In the moisture-free meal, left after the extraction of the fat from the kernels, 6·65 per cent. of proteins was found. The methods used by the natives for the preparation of the oils from the pericarp and the kernels are described. Both the pericarp and kernel oils have an agreeable taste and it is suggested that they could be used for edible purposes in the same way as palm oil and palm kernel oil.

Ground-nuts.—On account of the complaints made by merchants in 1925 on the unsatisfactory condition of ground-nuts exported from Nigeria, a series of investigations have been carried out by the Department of Agriculture in that Colony (*Dept. Agric. Nigeria, 5th Ann. Bull.*, 1926, p. 50). The factors that affect the value of

ground-nuts to the consumer are stated to be: the percentage of oil and the percentage of free fatty acids in the oil; the moisture; the proportion of shell and dirt; the percentage of whole kernels in decorticated nuts; the loss in weight (shrinkage) during storage in Kano; and the gain in weight during transit from Kano to the port in Europe.

For the purpose of the investigation samples were taken from decorticated nuts ready for export obtained from various sources. Examination showed the presence of only 45·1 per cent. of whole kernels as the average for 63 samples while the percentage of shell and dirt varied from 0·6–5·0, the mean being 1·6. In a good sample this last figure should not exceed 2 per cent. The loss of weight on storage at Kano was shown to be considerably greater in the case of ground-nuts purchased early in the season (October) than in the case of those bought later. On this account, as well as on account of deterioration through excessive moisture, it is considered advisable to wait until November before making purchases, whereby the nuts are given an opportunity of becoming sufficiently dry for the shrinkage to be no more than 3 per cent. This loss in weight (3 per cent.) due to shrinkage is found to be nearly compensated by the amount gained during transit from Kano to Ibadan. The variation in the oil-content of the decorticated ground-nuts was not great, the percentage of oil for 32 samples varying from 47·6 to 52·5 with an average of 50·0. Experiments were made showing that ground-nuts containing excessive moisture deteriorate when shipped in that condition and yield oil containing a high percentage of free fatty acids and with a greater liability to rancidity while, moreover, the cake may be rendered unfit for use as a feeding-stuff. It was also demonstrated that the oil obtained from whole kernels was less acid and of a lighter colour than that prepared from broken ones.

In connection with the harvesting of ground-nuts, experiments conducted at the Experimental Farm, Kano, have shown that when the crop is lifted in an immature condition, a lower return accrues to the producer than is the case when harvesting is deferred until the nuts are mature. Immature kernels shrivel on drying and yield an oil of low free fatty acid content, the percentage of oil not being markedly lower than that from mature kernels. When thoroughly dry, immature kernels do not deteriorate on keeping.

It is suggested that the quality of the ground-nuts exported should be controlled by means of a system of

inspection and grading, special attention being paid to the moisture-content of the kernels, the amount of shell and dirt present, and the proportion of whole kernels. Methods for the improvement of the quality are considered. The export of ground-nuts in the shell is not recommended owing to the increased cost of freight due to the 30 per cent. of shell; baling of the undecorticated nuts is considered inadvisable on account of the cost of transport to the baling centre from the outlying places where the nuts are grown. The quality of decorticated nuts could be raised by improving the native methods of shelling; by the introduction of hand-driven decorticating machines and by the establishment of central power-driven decortication plants. It is suggested that the kernels should be screened and graded before shipment. Shipment of decorticated nuts in bulk is recommended as being quicker and cheaper than their export in bags.

Investigations have been carried out at Pee Dee Experiment Station, Florence, S.C., on the effect of planting distances on the yield of ground-nuts. The results show that increased yields of nuts and hay may be obtained through closer planting than is now commonly practised. Experiments on the effect of the time of shelling on germination and yield showed that there is no consistent decrease in the germination of the seed or in the yield of nuts obtained from seed shelled several months before planting, as compared with the germination and yield from seed shelled shortly before planting. When shelling is done some time in advance of the planting, the utmost care should be exercised and the shelled seed stored in a dry and moderately cool place (*Dept. Bull. No.* 1478, 1927, *U.S. Dept. Agric.*).

Oil-Palm.—The methods for increasing the production of palm fruit in West Africa recommended by the Committee appointed by the Secretary of State for the Colonies in 1923 (see this BULLETIN, 1925, **23**, 358) are discussed in the *5th Annual Bulletin, Dept. Agric. Nigeria* (1926, p. 3). *Inter alia*, this Committee advocated the pruning of the trees, the cleaning of the heads and the removal of the bush. In connection with pruning it has been shown experimentally both in Sumatra and at the Moor Plantation, Nigeria, that pruning results in a decreased yield of fruit and therefore is unsuitable as a means for increasing production. Cleaning of the heads is already practised in Nigeria. Experiments conducted by the Agricultural Department on the effect of clearing the bush have shown

that this practice increases the yield of trees under 30 ft. high but has no important effect on the yield of taller trees; the benefit on the whole, however, is considered to be too small to be appreciated. As regards thinning out the stands, it is stated to be best to leave the palms of 30 ft. or more in height and thin out the shorter ones. The time gained in collecting fruit from short trees is not great. It is pointed out that the administration of a scheme of compulsory clearing and thinning of palm groves would present difficulties; the groves are usually communally owned and public opinion would be opposed to any attempt to enforce the carrying out of such a scheme.

The following method proposed by the Director of Agriculture is considered by him to be more suitable for increasing the production of palm fruit in Nigeria than those recommended by the Committee. All the tall palms of 25 ft. or more in height in a palm grove should be left, but they should not exceed more than 50 per acre. All shorter palms should be cut down. Seedlings at the rate of 60 per acre should be planted or that number of natural seedlings should be retained. The land should be regularly weeded. In order that this proposal might be readily adopted, each individual or family should be given the definite right over its own separate area so that each may receive the benefit of its own work. It is suggested, therefore, that the groves should be parcelled out on a lease (of, say, 15 years) on condition that clearing and planting are carried out, and on the understanding that at the expiration of this period, if the area has been satisfactorily managed, some form of permanent right will be given. This proposal should be carried out first on an experimental scale in two or three selected villages. A periodical inspection of the areas would be made to see that the management was being properly carried out.

In the same *Bulletin* (p. 24) an account is given of an investigation on the recovery of palm kernels from nuts depericarped in the course of the preparation of palm oil. The results of this investigation are summarised as follows: "Palm nuts may be prepared for immediate cracking by subjecting them to the action of live steam for 2 hours, and cooling them before feeding to the cracker. The speed of rotation of the cracker drum influences the proportion of broken kernels as well as the cracking efficiency. The separation of kernels from shell and unbroken nuts may be satisfactorily effected by means

of a suspension of clay in water. Kernels from steam-heated nuts must be dried before export. Two days' sun-drying or 7 days' air-drying in the shade reduces the moisture content of such kernels to the normal figure characteristic of commercial grades of kernels."

Investigations already carried out in Nigeria have shown that although the quality of palm oil may be improved by the exercise of greater care in the preparation of the fruit, the yield is not capable of being increased unless special apparatus is used (*loc. cit.* p. 33).

Of the methods previously reviewed (see this BULLETIN, 1924, **22**, 214, 497), the "soft oil process" is the most efficient. Its main faults are inefficient cooking, and the loss of oil through emulsification with water in the course of extraction and by insufficient squeezing.

A method is described in which the fruit is cooked with 2 to 3 gallons of water in a "Pioneer" or "Rapid" cooker for 1½ hours. These cookers are similar to one another, the "Pioneer" being a modification of the "Rapid." Both cookers are made by Messrs. Burford & Perkins, Ltd., Peterborough. The "Pioneer" cooker consists of a 50-gallon iron drum mounted over a furnace. The lower portion of the drum is jacketed so that the hot furnace gases have a slight superheating effect on the steam. The drum is provided with a closely-fitting lid and a perforated false bottom upon which the fruits rest and are kept out of contact with water. The capacity is 350 lb. of fruits. After being cooked the fruits are mashed in wooden mortars, care being taken to keep them as hot as possible. The mashed fruits are pressed at once in a hand screw-press whereby a certain quantity of oil is expressed. The cage of the press is emptied on to galvanised iron sheets and the nuts are picked out from the loose pericarp and cleaned by rubbing in a sieve. The pericarp is then placed in a 5-gallon drum, fitted with a well-fitting lid, and the drum and its contents are re-heated in the cooker for 20 minutes. The pericarp is then re-pressed, after which it is mashed again in the mortar and pressed once more. The oil obtained from the first pressing and the first runnings from the second should be kept separate from the later runnings as the former are of better quality. The free fatty acids in the oil prepared from fruits collected in the dry season should be less than 5 per cent. and from fruits gathered in the wet season less than 10 per cent. The mean efficiency of this process is 63·5 per cent. of the available oil. Among the advantages claimed for the process are: completion

of the extraction within a few hours; a small fuel consumption; a higher yield and a better quality of oil. On the other hand more persons are required to work the process than in the case of the native methods. The apparatus has to be imported and the separation of the pericarp from the nuts is a tedious process.

This method has been demonstrated at Oloburo, Abeokuta. Its superiority was recognised by the natives, but the women who normally extract the oil in the native processes complained that the work involved in the final stages of expression was too much for them. A sample of palm oil prepared by this method has been favourably reported upon by firms in the United Kingdom. It is recognised that before the method can be generally adopted, it will be necessary to overcome the natural reluctance of the natives to change their existing methods, and also the difficulty due to the cost of the imported apparatus.

In a previous number of this BULLETIN (1926, **24**, 694) reference was made to an article written by Yves Henry on the cultivation of the oil-palm in Sumatra in which he questioned the figures given in Dr. A. A. L. Rutger's monograph on "Investigations on Oil-Palms." M. Ferrand, technical adviser to the Société Financière des Caoutchoucs, Medan, has answered these criticisms in a recent issue of *Bull. Mat. Grasses* (1927, No. 1, p. 3). Figures are quoted to prove the possibility of a yield of 2,000–2,500 kilos. of palm oil per hectare from trees 10 to 12 years old under a system of selection. Henry's statement that all the plantations in Sumatra have been made with palms of the "Deli" type is refuted, large areas having been grown from seed imported from Africa. The question of selection and its possibilities is discussed by Ferrand, who also states that manurial experiments are being carried out. Observations made in Sumatra have shown that heavy soils are not suitable for the oil-palm; that the presence of humus is beneficial; and that lalang is harmful. *Callopogonium muconoides* is being sown between the lines to conserve the humus and to enrich the soil. The equipment of the factories and the processes employed in them have been so improved as to give a yield of nearly 27 per cent. of palm oil (calculated on the weight of the fruits). This yield can probably be still further increased to 29 to 30 per cent. by new processes of extraction with light petroleum which are now under trial. The acidity of the palm oil now being prepared is from 5 to 6 per cent.

An account of work which is being carried out at the Experimental Station, La Mé, Ivory Coast, on the selection of oil-palms is given in a comprehensive article published in *Bull. Ag. Gén. Col.* (1926, **19**, 1256, 1443; 1927, **20**, 21).

Shea Butter.—Under the auspices of the Institut Colonial de Marseille, a series of trials have been carried out in order to obtain from shea butter a deodorised and neutral product which does not turn rancid readily. The results of these trials are given in *Bull. Mat. Grasses* (1926, No. 3, p. 55; Nos. 8/9, p. 195; 1927, No. 1, p. 14). Experiments showed that the native-prepared butter could be successfully deodorised by steam after separation from any occluded water and filtration, but before neutralisation. Steam treatment did not remove the unsaponifiable matter, but it was found that from 20 to 25 per cent. of this constituent was removed by washing the butter with warm or boiling water. Agitation with 5 per cent. sulphuric acid at 80° C. removed about half of the unsaponifiable matter; the resulting product, however, turned rancid in 15 days after neutralisation. More promising results were obtained on treating the butter with sodium or potassium permanganate and sulphuric acid at 40–50° C. The resulting product possessed an objectionable after-taste and was on this account unsuitable for edible purposes. Trials to remove the after-taste have so far been unsuccessful. By this treatment with permanganate, the unsaponifiable matter was reduced in one sample from 5·7 to 0·6–0·9 per cent. and in another sample from 3·75 to 0·45–0·65 per cent. The product is suitable for soap manufacture and gives a soap of much better quality than does the untreated butter.

Neutralisation of the free fatty acids is best effected by using sodium carbonate at 90° C. to remove the greater portion, the final neutralisation being effected with caustic soda.

Bleaching can be successfully carried out by the use of oxidising agents, such as persulphates. Bleaching, however, has no appreciable effect on the odour or taste of the butter.

Essential Oils

Mentha satureiodes, known as Brisbane pennyroyal, is a small perennial herb usually under one foot in height which occurs in all the Australian States with the exception of Tasmania. The oil from this plant has been investigated by T. G. H. Jones and F. Berry-Smith, who

obtained 0·2 per cent. of oil from wilted plants received from the Dalby district of Queensland (*Proc. Roy. Soc. Queensland*, 1925, **37**, 89). This yield was appreciably lower than that previously obtained by Bailey, namely about 0·8 per cent. The oil resembled the pennyroyal oils of commerce in containing as principal constituent pulegone, which was present to the extent of 40 per cent. Other constituents identified were *l*-menthone 20 to 30 per cent., *l*-menthol 12 per cent., and menthyl acetate 8 per cent.

Fibres

Cotton

Dahomey.—Information on the progress of cotton-growing in Dahomey has been published in *Bull. de l'Agence Gén. des Col.* (1926, **19**, 1505). Cotton cultivation is an old-established industry in Dahomey and the country is known to be well suited for its production. Prior to 1924, the exports were only between 200 and 300 tons. In 1924 they amounted to 322 tons, in 1925 to 680 tons, and in 1926 no less than 1,025 tons were purchased by the exporters. At least 175 tons are used annually in the local weaving industry and the production in 1926 was therefore not less than 1,200 tons. These encouraging results are due to a serious effort which has been made to improve the crop in both quality and quantity. A complete programme extending over several years was drawn up and immediately put into operation. In order to reduce the cost of transport, ginneries have been established in various parts of the cotton area, which begins on the railway about 100 kilometres from the terminus and extends northwards to about 500 kilometres beyond the terminus. An endeavour is being made at the ginneries to improve the quality and yield of the cotton by repeated selection of the seed.

The cotton is of good quality and a firm of manufacturers has reported that it furnishes yarns superior to those spun from ordinary American cotton. The fibre is somewhat rough and is of good length and strength.

The country may be divided into three cotton-growing regions, each of which is adapted to a different kind of cotton. These are (1) the Abomey region and the south of the Savalou circle where *Gossypium barbadense* flourishes in the form of Sea Island; (2) the country between 8° and 10° in which a local acclimatised variety of *G. peruvianum* is grown; and (3) the north of Dahomey where quick-growing varieties of *G. punctatum* and *G. hirsutum* are cultivated.

Flax

A valuable communication on " Flax Rust and its Control," by A. W. Henry, has been published as *Technical Bulletin* 36 (1926) *of the University of Minnesota Experiment Station.* Flax rust, *Melampsora liniperda* (Körnicke) Palm, attacks all forms of *Linum usitatissimum*, whether grown for fibre or for seed. It occurs in all the principal flax-growing countries, and may reduce the yield of seed or damage the stems as a source of fibre and interfere with the retting. Interesting observations have been made of the behaviour of the rust in Minnesota and it has been found that there are great differences in the susceptibility of different varieties to the disease. Certain immune strains were used as parents in crosses with susceptible varieties and the results are described. Crosses were also made with wilt-resistant varieties of flax. As certain strains of Argentine flax are immune to rust and also highly resistant to wilt, it should be possible to obtain wilt resistance and immunity to rust in one and the same variety. It is pointed out that wilt resistance and immunity to rust are determined by different causes and are not necessarily correlated. Some varieties are known which are resistant to wilt but susceptible to rust, whilst others are very susceptible to wilt but immune to rust. The use of immune varieties is the most promising measure of control; these varieties should also be resistant to wilt. While susceptible varieties are still in use, efforts should be made to avoid infection; well cleaned home-grown seed should be used and should be sown early; low-lying soils should be avoided; and infected straw should be burnt or removed from the land before the new crop emerges.

A useful bibliography of the subject is appended.

Sisal Hemp

Nyasaland.—It is recorded in the *Ann. Report on the External Trade of the Nyasaland Protectorate* for the year ended December 31, 1926, that the exports of Sisal hemp in 1926 amounted to 529 tons as compared with 785 tons in the preceding year. It is pointed out that this decline in the exports does not signify that the industry is being curtailed. On the contrary, planting is being greatly extended, and a large area on which development had been suspended for some years has been re-opened.

Tanganyika.—During 1926 the exports of Sisal hemp from Tanganyika Territory amounted to 25,022 tons as against 18,276 tons in 1925, an increase of 37 per cent.

The highest figure previously recorded was 20,835 tons in 1913, and the industry has therefore now surpassed the position it had attained during the German occupation of the country.

It is stated in the *Home and Colonial Mail* of March 17, 1927, that the increased output is due partly to an improvement in the labour supply and partly to the fact that large areas planted about five years ago have now reached maturity. The replanting undertaken by the present owners of the older estates to compensate for the indiscriminate cutting done by temporary lessees immediately after the armistice is now bearing fruit. A number of new estates will also be reaching the producing stage shortly so that if favourable conditions continue a steady increase in the exports of fibre and tow may be anticipated.

Many parts of the Territory are eminently adapted to Sisal cultivation. The greater part of the present output is from the Pangani Valley, along the railway from Tanga to Moshi, in which the ex-German estates are situated. During recent years plantations have been established along the Central Tanganyika Railway between Dar-es-Salaam and Morogoro, and also in the Lindi district.

Triumfetta cordifolia

A study of the fibre of *Triumfetta cordifolia* or "Okon," produced in the French Cameroons, has been carried out by F. Heim de Balsac, with the collaboration of J. Maheu, G. S. Dagand, O. Roehrich and H. Heim de Balsac, and the results are recorded in *Bull. de l'Agence Gén. des Col.* (1926, **19**, 1453). The morphology and histological structure of the plant are fully described with the aid of excellent diagrams, and an account is given of the methods of cultivation. Chemical analysis of the fibre showed it to be composed of mineral constituents, 2·89 per cent.; fats and waxes, 0·80 per cent.; cellulose, 39·70 per cent.; and lignone, 56·61 per cent. The fibrous strands resemble those of jute and are 1·20 m.–1·50 m. long. The ultimate fibres are also similar to those of jute and have an average length of 2·2 mm.

In general, *T. cordifolia* fibre is of good length and of strength approximating to that of jute, but is inferior to the latter in fineness and flexibility. It cannot be spun in such fine counts as jute and would be best suited for use in cordage manufacture. The fibre could be exported but would only realise a low price, or it could continue to be used locally as at present for making bowstrings and fishing lines and for various domestic purposes.

Paper-making Materials

Corypha lævis Leaves.—An account of an investigation of the leaves of *Corypha lævis* (Lour.) A. Chev., the "Cay La Buong (Latanier)" of Annam, as a paper-making material, by F. Heim de Balsac, in collaboration with A. Deforge, G. S. Dagand, J. Maheu and H. Heim de Balsac, has been given in *Bull. de l'Agence Gén. des Col.* (1927, **20**, 51). The tree is abundant in the forests of South Annam and of the north-west of Cambodge. The young leaves are cut into strips which when sewn together serve for sails for the fishing boats and sampans which sail off the coast of Annam. They are also employed for the manufacture of mats, hats, bags and other articles.

The leaves contained 8·40 per cent. of moisture. On chemical analysis, they yielded 4·65 per cent. of ash, 0·60 per cent. of fats and waxes, 39·10 per cent. of cellulose, and 55·65 per cent. of lignone (expressed in each case on the moisture-free material). The ash contained 29·26 per cent. of silica, 13·15 per cent. of alumina, and 49·19 per cent. of lime.

On digesting the leaves with caustic soda of 3·5 per cent. strength for 6½ hours under a pressure of 3 kilos., a brownish-yellow pulp was obtained which bleached white without much difficulty. The yield of bleached pulp was 32·6 per cent. (expressed on the moisture-free leaves). On microscopical examination, the pulp was found to consist mainly of long fibres with a wide lumen; they vary in length from 0·44 to 1·77 mm., with an average of 1·4 mm., and have an average diameter of 10μ; the felting power (diameter : length) is 0·007. The pulp gives a "rattly" paper of a little less than average strength.

Gums and Resins

Elemi.—The oleo-resin from the Australian species *Canarium Muelleri* has been examined by T. G. H. Jones and F. Berry-Smith (*Proc. Roy. Soc. Queensland*, 1925, **37**, 92). It is a viscous mass, pale amber in colour and possessing the odour of turpentine. The resin furnishes 30 per cent. of essential oil, consisting principally of *l*-α-pinene; α-terpineol, dipentene, and *l*-α-phellandrene are also present. According to Clover the essential oil from Manila elemi (*C. luxonicum*), the principal elemi of commerce, is very variable in composition, the dominant constituent being usually either limonene or phellandrene. After the removal of the essential oil, the residual resin from *C. Muelleri* contained 7 per cent. of crystalline acids, 60 per cent. of amorphous resin alcohols, and 30 per cent. of resene material, of composition approximating to $C_{15}H_{24}O$.

Tanning Materials

F. Vignolo-Lutati and M. Chiera have contributed an article to *Bollettino Ufficiale, R. Stazione Sperimentale per l'Industria delle Pelli e delle Materie concianti, Napoli-Torino* (1926, **4**, 337–343) entitled " I baccelli di Sappan come materiale per concia e per tinta " (Sappan pods as a tanning and dyeing material). Two former notes by the first-named author made mention of the use of these pods (which are the product of *Caesalpinia Sappan*, L.) in the tanning industry; these were published in *Atti R. Accad. di Agric. di Torino*, 1922; and *Mercurio, Rivista di Studi applic. al Comm., Torino*, 1924.

The plant, a native of Japan, China, Siam, India, the Moluccas, etc., can be easily acclimatised in South Sardinia and is therefore considered to be of some importance as a possible source of tanning material for use in Italian industry. It grows vigorously and fruits abundantly in the chalky soil of the Botanic Gardens of Cagliari, in the high parts where the rocks come to within a few decimetres of the surface as well as in the lower parts where the soil is deeper, and shows great resistance to prolonged drought. The researches published in the earliest note mentioned above were chiefly concerned with the morphology of the fruit, their tannin content (about 40 per cent.), and the quality and characteristics of this material as compared with others already in use. As laboratory tests gave satisfactory results, practical tanning trials were carried out with (1) sappan alone, (2) sappan and quebracho, and (3) sappan, quebracho and chestnut, on calf skin and pickled and chrome tanned skins. In these trials the various operations proceeded without difficulty, and the leather obtained had a good appearance, uniformity, clearness of colour, resistance to stretching, etc.

As a result of these tests further work was undertaken on the pods, both as a tanning material and more particularly as a colouring agent. The authors state that leather tanned with sappan pods has a uniform bloom, is soft to the touch, firm, resistant, and compares favourably in colour with that obtained by the use of sumach, and they conclude that sappan can be advantageously used (1) as a substitute for sumach in light leather work, (2) as a substitute for special extracts for re-tanning and for the strengthening vats in the later stages of tanning with vegetable materials, and (3) as a substitute for gambier, mimosa, sumach and other materials in mixed chrome tannages.

Interesting results were obtained with sappan as a colouring material, and according to the authors it may

be usefully employed (1) as a substitute for sumach in dyeing with basic colours, (2) mixed with acid colours or directly in the dyeing vats, and (3) for the preparation of coloured lakes with metallic salts especially in the production of light goods.

For complete extraction of the dye from the pods the operation is carried out at 70–75° C., as in the cold only a portion of the dye is obtained. The colours produced with different metallic salts as mordants are described.

Sappan can be used in the form of a powder in all the tanning processes in which sumach powder is used, and the possibility of supplying the material to the trade in this form or as an extract is discussed.

The authors advocate the cultivation of *C. Sappan* in Italy, where it thrives on the chalky soils even in regions liable to prolonged drought, since the supply of quebracho and chestnut is rapidly diminishing, and synthetic tannins have only partly fulfilled expectations.

In conclusion a botanical description of *C. Sappan* is given, and a statement of the qualitative results obtained with Proctor's reagents with tanning infusions prepared from the pods.

Forestry and Timbers

British Guiana Forests.—The timber resources of an important and interesting area of the forest country of British Guiana are excellently dealt with in the *Report by the Conservator of Forests on the Valuation of the Forests of the Bartica-Kaburi Area,* published as a paper of the Combined Court (1926). The region concerned forms roughly a triangle with Bartica as its apex, the Essequebo and Mazaruni rivers as its sides, the base being afforded by a section of the Kaburi river; in this area the investigation of the forests and the valuation of the timber were carried out over a belt seven miles wide following the first section of the proposed route for a railway to Mazaruni starting from Bartica. The soils of the region are characteristically sandy, the greater part containing a small admixture of clay, the remainder comprising white coarse sands which probably occupy more than one-third of the whole. The report states that the two outstanding features of the forests traversed are (1) the occurrence (as almost certainly in other parts of the Colony) of compact untouched areas containing in quantity one of the finest timbers in the world (greenheart) within ten miles of a port where steamers up to 16 ft. draught can load ; and (2) the dominance, on large areas and among several hundred species of trees, of those

species which happen to be the most valuable commercially. The greenheart forests form the most important feature of the region. The species never occurs on the white sands which support the Wallabas (*Eperua falcata* and *E. Jenmani*), but usually at once appears where the soils are replaced by brown sands with a slight admixture of clay. Where the true greenheart forest occurs it is the dominant tree and few other large trees are found except the Kakeralli (*Lecythis* spp.) and the Morabukea (*Dimorphandra* sp., probably *D. Gonggrijpi*). The Wallaba forests comprise the soft Wallaba (*Eperua falcata*) and the ituri Wallaba (*E. Jenmani*), and are an example of the unusual occurrence in the tropics of a natural pure forest over wide areas; typical forests give as much as 75 per cent. of Wallaba trees over 16 ins. in diameter. The valuable Mora also occurs in important quantities, the tree growing along the banks and swampy flats of the streams. The trees, however, tend to a considerable percentage of unsoundness and have large plank buttresses. The Morabukea, as stated above, is a frequent constituent of the greenheart forests and is probably the same species as the Morabucquia of Surinam which has recently been described as *Dimorphandra Gonggrijpi*. Several Kakerallis also occur in the area. These trees are species of Lecythis, Eschweilera and Jugastrum, the most important being the black Kakeralli which is identical with the Surinam "Manbarklak"; efforts have been made to place the latter timber on the market in place of greenheart. The results of the survey indicate that the forests examined are valuable and offer stands as good as those of most virgin tropical rain forests while they contain timbers of high value in much larger quantities than is usual in such forests. The forests are capable of being exploited by modern methods and offer a high potential value in revenue to the State. Finally it is satisfactory to find that while the soil is on the whole unsuitable for agriculture it is adapted for growing forests of high quality for which fortunately the climatic conditions are also admirably suited.

Identification of Yawhooballi of British Guiana.—In *Tropical Woods*, 1927, No. 9, p. 8, an interesting botanical identification of a British Guiana timber tree is recorded. Timbers collected in British Guiana by the late Mr. A. C. Persaud for the Field Museum of Natural History, Chicago, contained an unidentified specimen labelled "Yawhooballi" which was tentatively identified at the Yale Tropical Laboratory as *Mollia* sp. (Tiliaceæ). This

identification was subsequently confirmed by Dr. H. A. Gleason at the New York Botanical Garden, who reported that the botanical specimen collected by Persaud matched exactly in foliage a specimen of Mollia collected by Jenman on the Upper Demerara River in 1888. The species has now been described as *Mollia sphærocarpa*, Gleason. A description of the timber is given by Prof. S. J. Record. It possesses a pale pinkish-brown heartwood with a lighter somewhat sharply defined sap. The lustre is dull and the odour and taste are not distinctive. It is somewhat fine textured, straight grained, easy to work, finishes smoothly, and would appear to be not durable. Weight 50 lb. per cu. ft.

Forestry in British Honduras.—The *Annual Report of the Forest Trust of British Honduras* for the year ended March 31, 1926, covers the operations of the fourth year during which the Forest Department of the Colony has been in existence. The policy of the Colonial government is to assist in every possible way through the Department the development of private forest projects, and the report points out that the augmentation of the forest staff effected during the year was chiefly in connection with this policy and was not on a scale sufficient to permit of any considerable expansion of forest operations in the Crown lands. Nevertheless there has been material expansion in sylvicultural operations and at the present time sylviculture is in progress in the Crown forests of five districts of the Colony, while in the sixth district are located the large-scale forest operations of the Belize Estate and Produce Co. and the Chicle Development Co.

Valuable experience has been gained regarding the degree of light required for the best development of natural mahogany seedlings, an irregularly broken canopy appearing to give the best results. So far results indicate that a natural seedling can, by successive cleanings, be brought up to the sapling stage (after which it will require little or no attention) at a total cost of not more than twenty-five cents.

Exploration and the collection of topographical data have been continued, with a view to the compilation of regional maps. A commencement has also been made with the examination of the practically unknown region of the western highlands, the work already having brought to light trees hitherto not known to occur in the Colony, as well as types of forest which have never been closely studied or described.

As regards the forest concessions on Crown lands the

operations of the Tidewater Lumber Co., who are engaged in developing secondary timbers, have been continued and a fair quantity of timber has been extracted for export, the produce going to the United States. During 1925 the proportions of timbers exported by this company were as follows: Banak (*Virola merendonis*, Pittier) 68 per cent., Santa Maria (*Calophyllum Calaba*, Jacq.) 23 per cent., and Yemeri (*Vochysia hondurensis*, Sprague) 9 per cent. An agreement has also been reached regarding the Chipley Pine Concession whereby it is hoped to secure rapid and early development of pine operations on the Placentia area of the Crown pine lands.

Under the heading of Research, reference is made to the enquiry into the possible use of the fast-growing softwoods occurring on sites of abandoned cultivation as a source of paper pulp, regarding which the advice of Mr. W. Raitt, of the Forest Research Institute, Dehra Dun, has been obtained. The work indicates that these species do not at present occur over sufficiently large areas to supply a pulping plant on a commercial scale. Experiments with a view to determining the possibility of growing these woods on short rotation as an intermediate stage in the reconstruction of hardwood forests are being continued.

Promising work has also been done in connection with the study of the trees yielding chicle gum (*Achras Sapota* and other sapotaceous species). Investigations on behalf of the Chicle Development Company have been carried out in Peten by W. D. Dorland of the Yale School of Forestry, in conjunction with Dr. P. C. Standley of the Smithsonian Institution, who is engaged in a botanical study of Sapotaceæ; while a member of the Forest Department has collected much practical information regarding the distribution and ecology of the species concerned and the methods of the "chicleros" in mixing and preparing the gums. The trial of improved methods of tapping the trees has also been carried out by the Chicle Development Company.

As regards the export trade of the Colony, it is notable that four-fifths of the Colony's wealth is derived from the forests. Mahogany is still by far the most important item (constituting, with cedar, 66·7 per cent. of the total trade), chicle (9·6 per cent.) taking second place. A feature of the year's trade has been the falling off in the American demand for mahogany, partly compensated by an improvement in the United Kingdom market. There has also been an increased output of mahogany lumber, notably for supply to Canada, but a decrease in

the demand for cedar. The trade in secondary woods with America is also worth note. The development of a trade in logwood with France is interesting, the commodity being required, it is believed, as a colouring agent in the wine industry.

"Redwood" in British Honduras.—A note in *Tropical Woods*, 1927, No. 9, p. 12, states that examination by Dr. Paul C. Standley of specimens collected in the Stann Creek District by Forest Ranger F. G. Burns has established the occurrence in British Honduras of the timber tree, *Calderonia salvadorensis*, Standl., known in Salvador as "redwood" and hitherto recorded only from that country. The timber receives its name from the bright red or pink colour of the freshly dried wood, a coloration which fades with continued exposure to light.

Pinus patula in South Africa.—Towards the end of 1902, the late Sir David Hutchins, at that time Conservator of Forests at Capetown, was commissioned to report on the possibilities of the Transvaal from an afforestation point of view. He strongly advocated the introduction of species from countries having climates similar to that of the Transvaal and referred specially to the temperate coniferous forests of the central plateau and of the ranges of the Sierra Madre of Mexico. In accordance with these suggestions seeds of several species were subsequently procured. The most promising of the introduced Mexican trees appears to be *Pinus patula*, which is now one of the main species upon which reliance is being placed to meet the future softwood requirements of South Africa. An account of its introduction and growth in the country is given by J. J. Kotze in *South African Journal of Science* (1926, **23**, 455).

P. patula is a very ornamental and graceful pine, which in its native country reaches a height, according to the records of different observers, of from 50 to 80 ft. So far as is definitely known it is confined in a wild state to elevations of about 6,000 to 8,000 ft. on the moist mountains on the eastern side of the Mexican plateau, which probably receive a rainfall of about 30 to 60 in., confined almost entirely to the summer months. In South Africa the tree has been found to thrive best on the comparatively moist mountain slopes of the eastern part of the country, where the conditions approximate to those of its native country. At Belfast in the Transvaal, at an elevation of 6,400 ft., a plantation of trees 13 years old, thinned to 415 trees to the acre, had an

average height of 68 ft., with a diameter at breast height of 8·2 in. Equally good results were obtained at Woodbush, also in the Transvaal, at an elevation of 4,900 ft. where a plantation of trees 12½ years old, thinned to 470 trees per acre, had an average height of 60 ft. and a diameter of 7·9 in. The tree has also proved to grow well in the Transkei, provided the soil is deep, and in the mist belts of Natal, such as on the slopes of Ingeli Mountains. In both these regions plantations of 12-year-old trees exceed an average height of over 50 ft.

Tests of the physical and mechanical properties of *P. patula* wood grown in South Africa have been carried out by N. B. Eckbo (*loc. cit.*, p. 467). The wood was cut from rapidly growing trees, at a very immature age, and consequently the results must not be taken as representing the quality of the mature wood. The physical tests showed that the wood is white, very light in weight, easily worked by machine or hand, almost free from resin, without odour or taste, readily stained or painted and suitable for gluing and nailing without splitting. The mechanical tests indicated that the wood is weak, brittle and soft. Wood from young trees would not be suitable for carrying heavy weights and would not stand hard wear, but it is considered that such material is specially adapted for box-making and should enjoy a very great demand for this purpose. Wood from older trees of a slower growth will possibly approach clear pine in mechanical properties and may replace this wood to a certain extent in the general building trade. The future market outlook for *P. patula* is regarded as very good.

Himalayan Spruce and Silver Fir.—The results of tests of the mechanical and physical properties of these two Indian timbers, carried out at the Forest Research Institute, Dehra Dun, are given by L. N. Seaman and C. R. Ranganathan in *Forest Bulletin, No.* 69, *Economy Series,* 1926.

Himalayan spruce (*Picea Morinda*) occurs in very large quantities in Northern India, from Afghanistan to Kumaon, generally at an elevation of from 7,000 to 11,000 ft. and commonly mixed with fir, deodar and kail (*Pinus excelsa*). Himalayan fir (*Abies Pindrow*) is also very abundant at about the same elevation from Afghanistan to Nepal, sometimes occurring in pure stands, but commonly associated with other conifers and sometimes with broad-leaved species. Very little timber of either species is extracted at present owing to lack of a market and the

cost of extraction. A conservative estimate gives the possible total annual yield from both trees as 6,700,000 cu. ft., of which 5,000,000 cu. ft. are available in Kashmir and 1,600,000 cu. ft. in the Punjab and North-West Frontier Provinces. Both trees grow to a large size.

It has been generally considered that the darker denser wood (" red-wood ") of the spruce obtained near the centre of the lower portion of the trunk is inferior to the ordinary " white-wood " of this species. Tests were accordingly made of both kinds of wood. The conclusions drawn from the results of the tests of the two kinds of spruce and of the silver fir may be summarised as follows :

Himalayan spruce and silver fir are somewhat stronger than the spruces and firs already tested in Canada and the United States. The "red-wood" of the spruce, when obtained from healthy living trees, is in no way inferior to spruce " white-wood." So far as can be judged from the material hitherto received at the Forest Research Institute, Himalayan silver fir is less knotty than Himalayan spruce and is somewhat stronger than that timber. Up to the present the use of Himalayan spruce and fir in aeroplane construction has been rendered impossible by the presence of knots and resin pockets in the material supplied. If, however, these timbers can be obtained reasonably free from the defects in question, it is considered that there is no reason why they should not make excellent substitutes for Sitka spruce.

Durability of Malayan Timbers.—The Forest Department of the Federated Malay States started in 1918 a series of tests to determine the resistance of various woods to the attacks of insect and of decay. The results of the tests so far obtained are recorded by Dr. Foxworthy in *Indian Forester* (1927, **53**, 25). In all more than 5,000 pieces of wood have been tested, including over 100 kinds of local woods, as well as certain well-known imported woods which were used for comparison. Pieces of wood 2 ft. long and 2 in. square were inserted upright in the ground so that about 6 in. projected above the soil, and the pieces were dug up and examined at intervals of six months. After being in the ground for five years, it was found that billian (*Eusideroxylon zwageri*) from Sumatra, greenheart (*Nectandra* sp.) from British Guiana and ingyin (*Pentacme siamensis*) from Burma, proved to be the most durable of the foreign woods and giam (*Hopea nutans*), resak (*Shorea* spp.), chengal (*Balanocarpus Heimii*), tempinis (*Sloetia sideroxylon*), tembusa (*Fagræa gigantea*),

merbau (*Intsia* sp.) and betis (*Payena utilis*) of the local woods. The chief cause of damage was white ants (termites), which are so plentiful and active in Malaya that few woods perish from decay. None of the woods may be said to be immune to white ant attack under the conditions prevailing in the Malaya, and it seems probable from the results obtained that a wood which is regarded as very durable in one country may not prove to be so in another. Thus teak, which is highly regarded in many places, has proved to be distinctly subject to white ant attack in Malaya.

BIBLIOGRAPHY

Comprising the more important reports, articles, etc., on plant and animal products, contained in publications received in the Library of the Imperial Institute during the three months March—May 1927.

The publications issued by the Governments of the Colonies and Protectorates can be obtained from or through the Crown Agents for the Colonies, 4, Millbank, Westminster, S.W.1. Applications for Dominion and Indian Government publications may be made to the Offices of the High Commissioners or Agents-General in London.

Agriculture

General

Rapport de l'Enquête Internationale sur l'Agriculture Tropicale et Subtropicale. Première Épreuve, 12 Mai, 1927. Pp. 37, 9½ × 6½. (Rome: Institut International d'Agriculture.)

Die wichtigsten Kulturpflanzen der Tropen und Subtropen in ihrer Abhängigkeit von der Landschaft (*cont.*). By E. Kastens. *Tropenpflanzer* (1927, **30**, 61–74).

Agricultural Research and Administration in the Non-Self-Governing Dependencies. Report of a Committee appointed by the Secretary of State for the Colonies. Pp. 101, 9½ × 6. (London: H.M. Stationery Office, 1927.) Price 2*s.*

The Agricultural Output of England and Wales, 1925. Pp. xv + 152, 9½ × 6. (London: H.M. Stationery Office, 1927.) Price 3*s.* 6*d.*

Agricultural Statistics of Bengal for the Year 1924–25. *Agric. and Indust. Dept., Bengal.* Pp. 39, 13 × 8½. (Calcutta: Bengal Secretariat Book Depot, 1926). Price Rs.3 (5*s.* 6*d.*).

Annual Reports on Agricultural Stations, Burma, for the Year ended June 30, 1926. Akyab and Kyaukpyu Coconut Farm, pp. 13, price As.6 (7*d.*). Hmawbi, pp. 29, price Re.1 (1*s.* 6*d.*). Mahlaing, pp. 21, price As.10 (11*d.*). Mandalay, pp. 28, price As.12 (1*s.* 1*d.*). Padu, pp. 22, price As.12 (1*s.* 1*d.*). Pwinbyu Seed Farm, pp. 28, price As.12 (1*s.* 1*d.*). Tatkon, pp. 27, price As.10 (11*d.*). (Rangoon: Superintendent, Government Printing, 1927.)

Report of the Economic Botanist, Burma, Mandalay, for the Year ended June 30, 1926. Pp. 7, 9½ × 6½. (Rangoon: Superintendent, Government Printing, 1927). Price As.4 (5*d.*).

Annual Report of the Agricultural Chemist, Burma, for the Year ending June 30, 1926. Pp. 9, 9½ × 6½. (Rangoon: Superintendent, Government Printing, 1927.) Price As.4 (5*d.*).

Annual Report of the Agricultural Engineer, Burma, Mandalay, for the Year ended June 30, 1926. Pp. 4, 9¾ × 6¼. (Rangoon: Superintendent, Government Printing, 1927.) Price As.2 (*2d.*).

Annual Report of the Agricultural Department, Mysore, for the Year 1925–26, Parts I and II. Pp. 4 + 91, 13 × 8¼. (Government of Mysore, General and Revenue Departments, 1927.)

The Zionist Organisation. Institute of Agriculture and Natural History. Agricultural Experiment Station. First Report Covering a Period of Five Years, 1921–26. Pp. 103, 9¼ + 6¼. (Tel-Aviv, Palestine: Agricultural Experiment Station, 1926.)

Colony and Protectorate of Kenya. Agricultural Census. Seventh Annual Report, 1926. *Dept. Agric., Kenya.* Pp. 34, 9½ × 6¼. (Nairobi: Government Printer, 1927.)

Fifth Annual Bulletin of the Agricultural Department, Nigeria. Pp. 209, 10¼ × 8¼. (Lagos: Government Printer, 1926.) Price 5*s.* post free.

Report of the Director of Irrigation, Union of South Africa, for the Period April 1, 1925, to March 31, 1926. Pp. 23, 13 × 8¼. (Cape Town: Government Printer, 1927.) Price 1*s.* 6*d.*

Report of the Department of Agriculture, Tanganyika Territory, for the Year ending March 31, 1926. Pp. 37, 13 × 8¼. (Dar es Salaam: Government Printer.)

Report on the Agricultural Department, St. Kitts-Nevis, 1925–26. Pp. 30, 13 × 8¼. (Trinidad: Imperial Commissioner of Agriculture for the West Indies, 1927.) Price 6*d.*

Agricultural Research in the British Empire. IV—Agricultural Research in Australia. By F. L. M'Dougall and A. S. Fitzpatrick. *Scottish Journ. Agric.* (1927, **10**, 171–180).

Report of the Department of Agriculture for New South Wales, for the Year ended June 30, 1926. Pp. 37, 13 × 8¼. (Sydney: Government Printer, 1927.) Price 2*s.* 6*d.*

Agricultural Yearbook, 1925, United States Department of Agriculture. Pp. 1537, 9 × 6. (Washington: Government Printing Office, 1926.) Price $1.50.

Forty-ninth Report of the Connecticut Agricultural Experiment Station for the Year 1925. Comprising *Bulletins* 270–281, pp. 721; *Tobacco Station Bulletin* 6, pp. 93; and *Bulletins of Immediate Information* Nos. 51–54, pp. xxxv, 9 × 6. (New Haven: State of Connecticut, 1926.)

University of Florida Agricultural Experiment Station. Report for the Fiscal Year ending June 30, 1926, with Bulletins 175–183 and Press Bulletins 369–389. Pp. 125 + 423 + 42 + vi, 9 × 6. (Gainesville, Florida: Experiment Station, 1926.)

Director's Report. Agricultural Experiment Station, Kansas, for the Biennium July 1, 1924, to June 30, 1926. Pp. 162, 9 × 6. (Manhattan, Kansas: State Agricultural College, 1926.)

Forty-first Annual Report of the Maine Agricultural Experiment Station, 1925. Comprising *Bulletins* 322–328 and *Official Inspections* 115–118. Pp. xv + 275 + 72, 9 × 6. (Orono, Maine: State University, 1926.)

Annual Report of the Director, Agricultural Experiment Station, Wisconsin, 1924–26. *Bull.* 388. Pp. 145, 9 × 6. (Madison, Wisconsin: State University, 1926.)

Rules for Seed Testing. *Dept. Circ.* 406, *U.S. Dept. Agric.* Pp. 12, 9 × 6. (Washington: Government Printing Office, 1927.) Price 5 cents.

Electricity in Agriculture. By C. A. Cameron Brown. *Journ. Min. Agric.* (1927, **34**, 121–125; 258–262).

The Use of Explosives on the Farm. By A. J. Schwantes. *Spec.*

Bull. No. 110, *Minnesota Agric. Exper. Sta.* Pp. 20, 9 × 6. (Minnesota: State University College of Agriculture, 1926.)

Insect Control of Noxious Weeds. Joint Scheme initiated against Blackberry and other Species [in New Zealand]. *New Zealand Journ. Agric.* (1927, **34**, 84–90).

Prickly Pear. Botanical Description, History and the Problem the Plant Presents. By G. P. Darnell-Smith. *Agric. Gaz., N.S.W.* (1927, **38**, 311–316, *cont.*).

The Water Hyacinth Pest. By W. C. Lester-Smith. *Leaflet No.* 40, *Dept. Agric., Ceylon.* Pp. 4, 10 × 6½. (Colombo: Government Printer, 1926.) Price 5 cents.

The Soil

Note on Some Physical Properties of Soils. By B. de C. Marchand. *S. African Journ. Sci.* (1926, **23**, 238–243).

A Study of Absorption of Moisture by Soils. By Jatindra Nath Sen and Bhailal Motibhai Amin. *Mem. Dept. Agric., India, Chem. Ser.* (1927, **8**, No. 12, pp. 235–253). Price As.6 (9*d.*).

Some Data Concerning the Salt Lands of Palestine. By F. Menchikovsky. Reprint from *Agricultural Records* No. 1 of the P.Z.E. Institute of Agriculture and Natural History, Tel-Aviv, Feb. 1927, pp. 39–60.

Injury to Growing Crops Caused by the Application of Arsenical Compounds to the Soil. By H. E. Morris and D. B. Swingle. *Journ. Agric. Res.* (1927, **34**, 59–78).

Some Effects of Calcium Compounds on the Soil and on Plant Growth. By W. T. H. Williamson. *Scottish Journ. Agric.* (1927, **10**, 180–184).

Phosphorus Deficiency in South African Soils and Vegetation. By J. P. van Zyl. *S. African Journ. Sci.* (1926, **23**, 244–252).

The Availability of Phosphates in Calcareous or Alkaline Soils. By J. F. Breazeale and P. S. Burgess. *Tech. Bull. No.* 10, *Arizona Agric. Exper. Sta.* Pp. 29, 9 × 6. (Tucson, Arizona: State University, 1926.)

Over de Hygroscopiciteit var Eenige Kunstmeststoffen. *Berichten van de afdeeling Handelsmuseum van de Kon. Vereeniging Koloniaal Instituut,* No. 27. Pp. 21, 8½ × 5½. (Amsterdam, 1926.) Reprinted from *Indische Mercuur,* Aug. 18, 1926.

Kiemproeven met Zaden van verschillende Groenbemesters, I en II. (Germinating experiments with seeds of different species of green manures, I and II). By J. G. J. A. Maas. *Med., Alg. Proefsta., A.V.R.O.S., Alg. Ser. No.* 27. Pp. 33 + 34 tables, 10½ × 7½. (Medan: Varekamp & Co., 1926.)

Sclerotium Rolfsii, Sacc. en *Rhizoctonia solani* op *Indigofera endecaphylla.* By J. Schweizer. *Arch. Rubbercult.* (1927, **11**, 150–154).

The Organic Matter in Heavy Alkaline Soils. By A. F. Joseph and B. W. Whitfeild. *Journ. Agric. Sci.* (1927, **17**, 1–11).

Nitrifying Power of some Philippine Soils. By M. M. Alicante. *Phil. Journ. Sci.* (1927, **32**, 1–27).

The Reversion of Nitrates in the Soil under Cultural Conditions in Mauritius. By N. Craig and F. Giraud. *Bull. No.* 11, *Sci. Ser., Dept. Agric., Mauritius.* Pp. 19, 9½ × 6¼. (Port Louis: Government Printer, 1926.)

Root Nodule Bacteria of Leguminosæ. By E. B. Fred, A. L. Whiting and E. G. Hastings. *Res. Bull.* 72, *Wisconsin Agric. Exper. Sta.* Pp. 43, 9 × 6. (Madison, Wisconsin: State University, 1926.)

The Growth of Certain Micro-organisms in Planted and in Unplanted Soil. By J. K. Wilson and T. L. Lyon. *Mem.* 103, *Cornell Agric.*

Exper. Sta. Pp. 25, 9 × 6¼. (Ithaca, New York: Cornell University, 1926.)

Some Protozoa found in Certain South African Soils.—VI. By H. B. Fantham and N. F. Paterson. *S. African Journ. Sci.* (1926, **23**, 667–705).

Insect Pests—General

Applied Entomology in Relation to the Agricultural Resources of a Country. By H. H. King. *Emp. Cotton Growing Rev.* (1927, **4**, 137–142).

Recent Work on Some Pests of Economic Crops. [Tea, Green Manure and Shade Trees, Cotton, etc.] By J. C. Hutson. *Trop. Agric., Ceylon* (1927, **68**, 220–228).

Life History Notes on the Rutherglen Bug (*Nysius* sp.). By J. H. Smith. *Queensland Agric. Journ.* (1927, **27**, 285–302).

Poison Dusting for Locusts. By L. J. Newman. *Journ. Dept. Agric., W. Austr.* (1927, **4**, 2nd Ser., 101–104).

Insecticides and Fungicides. By C. C. Gowdey. *Entom. Circ. No.* 12, *Dept. Agric., Jamaica.* Pp. 12, 9½ × 6. (Kingston: Government Printing Office, 1927.)

Fish Oil, an Efficient Adhesive in Arsenate-of-Lead Sprays. By C. E. Hood. *Dept. Bull. No.* 1439, *U.S. Dept. Agric.* Pp. 21, 9 × 6. (Washington: Government Printing Office, 1926.) Price 10 cents.

The Stationary Spray Plant. By H. L. Garver. *Gen. Bull. No.* 212, *Washington Agric. Exper. Sta.* Pp. 42, 9 × 6. (Pullman, Washington: State College, 1927.)

Fungoid Diseases—General

Annual Report of the Mycologist, Burma, for the Year ended June 30, 1926. Pp. 7, 9¾ × 6¼. (Rangoon: Superintendent, Government Printing, 1927.) Price As.4 (5*d*.).

Landmarks in the Development of the Science of Plant Pathology and of Disease Control. By P. A. Van der Bijl. Presidential Address to Section C, South African Association for the Advancement of Science, 1926. *S. African Journ. Sci.* (1926, **23**, 42–60).

The Nature and Inheritance of Resistance to Fungous Diseases in Plants. By A. R. Saunders. *S. African Journ. Sci.* (1926, **23**, 308–324).

Recent Work on Root Disease of Economic and Other Plants in Ceylon. By W. Small. *Trop. Agric., Ceylon* (1927, **68**, 201–212).

Further Notes on *Rhizoctonia bataticolor* (Taub.) Butler. By W. Small. *Trop. Agric., Ceylon* (1927, **68**, 73–75).

Tropical Fusaria. By O. A. Reinking and H. W. Wollenweber. *Philippine Journ. Sci.* (1927, **32**, 103–253).

Some Aspects of the Virus Disease Problem in Plants. By A. R. Saunders. *S. African Journ. Sci.* (1926, **23**, 295–304).

Foodstuffs

General

Experiments with Varieties of Food Crops conducted by the Department of Agriculture, Mauritius, 1921–26. By H. A. Tempany. *Bull. No.* 37, *Gen. Ser., Dept. Agric., Mauritius.* Pp. 21, 9¾ × 6¼. (Port Louis: Government Printer, 1926.)

Fruits and Vegetables. By L. C. Corbett, H. P. Gould and W. R. Beattie. *Agric. Yearbook*, 1925, *U.S. Dept. Agric.*, pp. 107–124.

Relation of the Fruit and Vegetable Industry to other Farm Enterprises. By L. C. Corbett, W. R. Beattie and H. R. Tolley. *Loc. cit.*, pp. 125–131.

Nutritive Value of Fruits, Vegetables and Nuts. By C. L. Hunt. *Loc. cit.*, pp. 133–149.

Fruit and Vegetable Production. By L. C. Corbett and others. *Loc. cit.*, pp. 151–452.

Diseases and Pests of Fruits and Vegetables. By M. B. Waite and others. *Loc. cit.*, pp. 453–599.

Horticultural Manufactures (Canning, Fruit Juices, Potato Starch, etc.). By L. C. Corbett and others. *Loc. cit.*, pp. 601–622.

Marketing Fruits and Vegetables. By A. W. McKay and others. *Loc. cit.*, pp. 623–710.

Beverages

Über Kakaohefen. Ein Beitrag zur Kenntnis der Biologie der Kakaofermentation. By O. A. von Lilienfeld-Toal. *Beiheft zum Tropenpflanzer*, No. 1, Vol. 24, 1927, pp. 1–48.

"Collar Crack" of Cacao (*Armillaria mellea* (Vahl) Fr.). By H. A. Dade. *Bull. No. 5, Dept. Agric., Gold Coast.* Pp. 21 + 17 Plates. (Accra: Government Printer, 1927.)

Kiemphysiologische Proeven met Koffiezaad. By J. Schweizer. *Arch. voor de Koffiecultuur* (1927, **1**, No. 6, 249–266; summary in English, pp. 269–271).

Desinfectie van door Bessenboeboek (*Stephanoderes Hampei*, Ferr.) aangetast Koffiezaad. By J. G. J. A. Maas and K. B. Boedijn. *Arch. voor de Koffiecultuur* (1927, **1**, No. 6, 233–247; summary in English p. 248).

Gedenkboek der Nederlandsch Indische Theecultuur, 1824–1924. Uitgegeven door het Proefstation voor Thee bij Gelegenheid van het Theecongres met Tentoonstelling, Bandoeng, 1924. Pp. 241, $10\frac{3}{4} \times 7\frac{1}{4}$. (Weltevreden: G. Kolff & Co.)

Green Crops [for Tea]. By P. H. Carpenter. *Quart. Journ., Sci. Dept., Ind. Tea Assoc.* (1926, Part IV, pp. 170–175).

Trials of Phosphatic Manures [for Tea]. By H. R. Cooper and P. B. Sen Gupta. *Quart. Journ., Sci. Dept., Ind. Tea Assoc.* (1926, Part IV, pp. 176–183).

Spraying [of Tea] at Sylee. By C. R. Harler. *Quart. Journ., Sci. Dept., Ind. Tea Assoc.* (1926, Part IV, pp. 143–156).

Mites as Pests of the Tea Plant. By S. Stuart Light. *Trop. Agric., Ceylon* (1927, **68**, 229–238).

Manuring in Relation to the Control of Shot-hole Borer of Tea (*Xyleborus fornicatus*). By F. P. Jepson and C. H. Gadd. *Bull. No.* 78, *Dept. Agric., Ceylon.* Pp. 49, $8\frac{1}{2} \times 5\frac{1}{2}$. (Colombo: Government Printer, 1926.)

Some Diseases of the Tea Bush. By C. H. Gadd. *Trop. Agric., Ceylon* (1927, **68**, 213–219).

Over de Samenstelling van Eenige op Verschillende wijzen bereide Theeëxtracten. *Berichten van de afdeeling Handelsmuseum van de Kon. Vereeniging Koloniaal Instituut*, No. 28. Pp. 22, $8\frac{1}{2} \times 5\frac{3}{4}$. (Amsterdam, 1927.) Reprinted from *Indische Mercuur*, Dec. 29, 1926.

Cereals

Common Smuts and Rusts of Corn Crops. *Journ. Dept. Lands and Agric., Ireland* (1927, **26**, 199–207).

Report of Proceedings of Fourth Maize Conference, held at Nairobi, Kenya Colony, 1926. Pp. 41, $9\frac{3}{4} \times 6\frac{1}{4}$. (Nairobi: Government Printer, 1927.)

Cost of Production of Maize. Report on the Investigation for the Season 1923–24. By D. W. McKellar. *Sci. Bull. No. 52, Dept. Agric., Un. S. Afr.* Pp. 28, $9\frac{1}{2} \times 6$. (Pretoria: Government Printing Office, 1926.) Price 3*d*.

Storage of Maize in Coastal Districts. By H. Wenholz. *Agric. Gaz., N.S.W.* (1927, **38**, 255–261; *cont.*).

A Progress Report on the Investigations of the European Corn Borer. By D. J. Caffrey and L. H. Worthley. *Dept. Bull. No.* 1476, *U.S. Dept. Agric.* Pp. 154, 9 × 6. (Washington: Government Printing Office, 1927.) Price 35 cents.

The Growing of Oats. *Journ. Dept. Lands and Agric., Ireland* (1927, **26**, 221–228).

Essentials in Oat Growing. By J. T. Pridham. *Agric. Gaz., N.S.W.* (1927, **38**, 225–229).

Crane Fly Grub and the Oat Crop. By J. Rennie. *Scottish Journ. Agric.* (1927, **10**, 184–195).

Autour de la riziculture indochinoise. By P. Vieillard. *Agron. Colon.* (1927, **16**, No. 110, 49–56; No. 111, 74–81; *cont.*).

Posibilidad del Cultivo del Arroz en Cuba. By B. Muñoz Ginarte. *Rev. de Agric., Cuba* (1927, **8**, No. 5, 14–20).

Wheat-growing in the South-west and Riverina (*cont.*). By E. S. Clayton. *Agric. Gaz., N.S.W.* (1927, **38**, 135–142).

Correlated Inheritance in Wheat. By G. Stewart. *Journ. Agric. Res.* (1926, **33**, 1163–1192).

Chemistry of New Zealand Wheats and Flours. II. The Hydration Capacity of Gluten from some Local Samples. By L. D. Forster. *New Zeal. Journ. Sci. and Tech.* (1926, **8**, 299–304).

Testing Wheat for Protein with a Recommended Method for Making the Test. By D. A. Coleman, H. C. Fellows and H. B. Dixon. *Dept. Bull. No.* 1460, *U.S. Dept. Agric.* Pp. 32, 9 × 6. (Washington: Government Printing Office, 1926.) Price 5 cents.

Some Diseases of Wheat Crops and their Treatments. By W. J. Spafford. *Journ. Dept. Agric., S. Austr.* (1927, **30**, 678–692).

Copper Powders for the Prevention of Bunt in Wheat. By E. J. Limbourn and G. L. Throssell. *Journ. Dept. Agric., W. Austr.* (1927, **4**, 2nd Ser., 92–97).

Flag Smut of Wheat. Varietal Resistance Test. By W. M. Carne and E. J. Limbourn. *Journ. Dept. Agric., W. Austr.* (1927, **4**, 2nd ser., 4–7).

Sugar

Report on the Results obtained at the Government Experiment Station for the Investigation of Problems connected with the Irrigation of Sugar Cane at Medine, Mauritius, 1921–26. By H. A. Tempany. *Bull. No.* 36, *Gen. Ser., Dept. Agric., Mauritius.* Pp. 57, 9¾ × 6¼. (Port Louis: Government Printer, 1926.)

The Canadian Sugar Industry. By E. L. Chicanot. *Int. Sugar Journ.* (1927, **29**, 134–137).

Twenty-sixth Annual Report of the Bureau of Sugar Experiment Stations, Queensland. Pp. 82, 13 × 8¼. (Brisbane: Government Printer, 1926.)

Notes on some British West Indian Sugar Crops of 1926. By Sir Francis Watts. *Int. Sugar Journ.* (1927, **29**, 73–77; 154–158).

Sugarcane Breeding—Indications of Inheritance. By Rao Saheb T. S. Venkatraman. *Mem. Dept. Agric. India, Bot. Ser.* (1927, **14**, No. 3, pp. 113–129). Price As.8 (10*d*.).

Report on Jaggery Making from Sugar Cane Juice. By W. P. A. Cooke and N. Senathiraja. *Trop. Agric., Ceylon* (1927, **68**, 76–79).

Control of Sugar-Beet Nematode by Crop Rotation. By G. Thorne. *Farmers' Bull. No.* 1514, *U.S. Dept. Agric.* Pp. 20, 9 × 6. (Washington: Government Printing Office, 1926.)

Sugar-Cane Diseases of North America and the West Indies. By A. F. Bell. *Queensland Agric. Journ.* (1927, **27**, 99–104).

Leaf-scald, a Bacterial Disease of the Sugar Cane. *Int. Sugar Journ.* (1927, **29**, 151–154).

Sugar Beet Growing. *Journ. Min. Agric.* (1927, **34**, 36–45).

Root Crops

A Preliminary Report on Tapioca Varieties grown at the Government Plantation, Serdang. By J. Lambourne. *Malayan Agric. Journ.* (1927, **15**, 41–59).

Investigations on the Leaf-roll and Mosaic Diseases of the Potato. By P. A. Murphy and R. McKay. *Journ. Dept. Lands and Agric., Ireland* (1927, **26**, 295–305).

Virus Diseases of Potatoes and the Raising of Seed Potatoes in the Irish Free State. By H. Southwell. *Journ. Min. Agric.* (1927, **34**, 19–25).

The Relative Efficiency of some Copper Dusts and Sprays in the Control of Potato Diseases and Insect Pests. By O. C. Boyd. *Bull.* 451, *Cornell Agric. Exper. Sta.* Pp. 68, 9 × 6. (Ithaca, New York: Cornell University, 1926.)

The Experimental Cultivation of Sweet Potatoes at the Government Plantation, Serdang. By J. N. Milsum and E. A. Curtler. *Malayan Agric. Journ.* (1927, **15**, 12–20).

Fruits

Report on Fruit Marketing in England and Wales. *Econ. Ser. No.* 15, *Min. Agric. and Fish.* Pp. 152, 9½ × 6. (London: H.M. Stationery Office, 1927.) Price 6*d*.

Harvesting, Packing and Marketing of Deciduous and Tropical Fruits. By G. W. Marshall. *Rhodesia Agric. Journ.* (1927, **24**, 420–437).

Eenige mededeelingen over het conserveeren van versche vruchten met rubbermelksap. By W. Spoon. *Berichten van de afdeeling Handelsmuseum van de Kon. Vereeniging Koloniaal Instituut,* No. 29. Pp. 12, 8½ × 5½. (Amsterdam, 1927.) Reprinted from *Indische Mercuur,* Jan. 19, 1927.

Temperature Conditions in Refrigerated Holds carrying Apples. By A. J. M. Smith. *Spec. Rept. No.* 27, *Food Invest., Dept. Sci. and Indust. Res.* Pp. 52, 9½ × 6½. (London: H.M. Stationery Office, 1927.) Price 1*s*. 6*d*.

A Report on Certain Diseases of the Apple in the Nelson District, New Zealand, 1925–26. By T. Rigg assisted by L. W. Tiller. *Chem. and Agric. Dept. Bull. No.* 4B, *N.S., Cawthron Inst., Nelson, N.Z.* Pp. 7, 9½ × 6½. (Auckland: Brett Printing Co., Ltd., 1927.)

A Progress Report on the Removal of Spray Residue from Apples and Pears. By R. H. Robinson and H. Hartman. *Bull.* 226, *Oregon Agric. Exper. Sta.* Pp. 46, 9 × 6. (Corvallis, Oregon: Agricultural College, 1927.)

Banana Culture in Hawaii. By W. T. Pope. *Bull. No.* 55, *Hawaii Agric. Exper. Sta.* Pp. 48, 9 × 6. (Washington: Government Printing Office, 1926.) Price 20 cents.

The Banana Thrips (*Anaphothrips signipennis*). By J. L. Froggatt. *Queensland Agric. Journ.* (1927, **27**, 186–190).

The Control of Aphis on Black Currants. By C. E. Hudson. *Journ. Min. Agric.* (1927, **33**, 1121–1127).

Economic Aspects of Citrus-Fruit Growing in Polk County, Fla. By C. R. Swinson and W. C. Funk. *Dept. Bull. No.* 1435, *U.S. Dept. Agric.* Pp. 40, 9 × 6. (Washington; Government Printing Office, 1926.) Price 10 cents.

Manurial and Fertiliser Practice in Citrus Production. An examination of Southern Californian methods. By W. Le Gay Brereton. *Agric. Gaz., N.S.W.* (1927, **38**, 263–268).

Citrus Insects and their Control. By J. R. Watson. With Sections on Entomogenous Fungi by E. W. Berger. *Bull.* 183, *Florida Agric. Exper. Sta.* (a revision of *Bull.* 148). Pp. 135, 9 × 6. (Gainesville, Florida: Agricultural Experiment Station, 1926.)

The Cranberry in Oregon. By W. S. Brown. *Bull.* 225, *Oregon Agric. Exper. Sta.* Pp. 31, 9 × 6. (Corvallis, Oregon: Agricultural College, 1927.)

Custard Apple (*Anona Cherimolia*). By G. Williams. *Queensland Agric. Journ.* (1927, **27**, 124–126).

Propagation of the Date Palm, with Particular Reference to the Rooting of High Offshoots. By F. J. Crider. *Bull. No.* 115, *Arizona Agric. Exper. Sta.* Pp. 19, 9 × 6. (Tucson, Arizona: State University, 1926.)

The Fig Wax Scale (*Ceroplastes rusci*, Linn.) in Palestine. By G. E. Bodkin. *Bull. Entom. Res.* (1927, **17**, 259–261).

Grape Export Problem. By S. Fish. *Journ. Agric., Victoria* (1927, **25**, 31–39).

American Stocks. Investigations of Grafted Vines. By S. W. Van Niekerk and C. J. Theron. *Bull. No.* 10, 1927, *Dept. Agric., Un. S. Afr.* Pp. 11, 9½ × 6. (Pretoria: Government Printing and Stationery Office, 1927.)

Cultivo del Mango en Cuba. By F. Agete. *Rev. de Agric., Cuba* (1927, **8**, No. 4, 3–13).

The Budding of Mangoes. By M. S. Goodman and L. A. Powell. *Misc. Circ. No.* 1, *Dept. Sci. and Agric., Jamaica.* Pp. 3, 10 × 6½. (Kingston: Government Printing Office, 1926.)

Pecan Scab. By R. E. Nolen. *Bull.* 181, *Florida Agric. Exper. Sta.* Pp. 28, 9 × 6. (Gainesville, Florida: Agricultural Experiment Station, 1926.)

Dusting with Monohydrated Copper Sulphate and Lime for Control of Pecan Scab. By J. B. Demaree and J. R. Cole. *Dept. Circ.* 412, *U.S. Dept. Agric.* Pp. 8, 9 × 6. (Washington: Government Printing Office, 1927.) Price 5 cents.

Fodders and Forage Crops

The Composition of the Main Feeding Stuffs in Palestine. By F. Menchikovsky. *Circ.* 12, *Agric. Exper. Sta., Tel-Aviv.* Pp. 6, 9 × 6. (Tel-Aviv, 1927.) In Hebrew, with summary in English.

Culture des plantes fourragères dans le Sud-Ouest de Madagascar. By H. L. Poisson. *Bull. Écon., Madagascar* (1926, No. 1, pp. 165–170).

Montgomery and Cornish Marl Red Clover. By R. D. Williams. *Journ. Min. Agric.* (1927, **34**, 133–146).

The Improvement of Poor Pasture in Yorkshire. *Rep. No.* 150, *Univ. of Leeds and Yorks. Council for Agric. Educ.* Pp. 28, 8½ × 5½. (Leeds: Department of Agriculture, The University, 1927.)

The Grasslands of New Zealand. Regrassing Experiments on Deteriorated Hill Country in Whangamomona County, 1925 and 1926 By E. Bruce Levy. *New Zeal. Journ. Agric.* (1927, **34**, 73–83; 145–164; *cont.*).

Characters which determine the Economic Value of Grasses. By R. G. Stapledon. I. Nutritive Value and Palatability. *Journ. Min. Agric.* (1927, **33**, 1083–1091). II. Ratio of Leaf to Stem, *loc. cit.* (1927, **34**, 11–19). III. Tiller Production and Powers of Resistance to Repeated Defoliation, *loc cit.* (1927, **34**, 146–154). IV. Persistency and Aggressiveness, *loc. cit.* (1927, **34**, 251–258).

The Origin, Composition, Nutritive Value and Uses of Dried Sugar-Beet Pulp. By E. T. Halnan. *Journ. Min. Agric.* (1927, **34**, 175–179).

Silage, Ensilage and Silos (*cont.*). By G. L. Sutton. *Journ. Dept. Agric., W. Austr.* (1927, **4**, 2nd Ser., 33–58).

Losses in Silage-Making at the Albert Agricultural College. By J. P. Drew and G. T. Pyne. *Journ. Dept. Lands and Agric., Ireland* (1927, **26**, 208–214).

A Preliminary List of the Known Poisonous Plants found in South Africa. By E. P. Phillips. *Mem. No.* 9, *Bot. Surv., S. Africa.* Pp. 30, 9½ × 6. (Pretoria: Government Printing Office, 1926.) Price 2*s.* 6*d.*

The Toxicity of the Genus Cotyledon, the Cause of the Disease Krimpsiekte. By P. Kamerman. *S. African Journ. Sci.* (1926, **23**, 185–187).

The Selection of Burma Beans (*Phaseolus lunatus*) for Low Prussic Acid Content. By J. Charlton. *Mem. Dept. Agr. India, Chem. Ser.* (1926, **9**, No. 1, pp. 1–36.) Price As.10 (1*s.*).

Les Plantes à acide cyanhydrique. By L. Rigotard. *Agron. Colon.* (1927, **16**, No. 109, 19–22).

Oils and Oil Seeds

Production et Commerce des Produits Oléagineux et Huiles Végétales. Pp. 192, 9½ × 6¾. (Rome: International Institute of Agriculture, 1926.) Price 15 lires.

Production and Utilization of Fats, Fatty Oils and Waxes in the United States. *Dept. Bull. No.* 1475, *U.S. Dept. Agric.* Pp. 36, 9 × 6. (Washington: Government Printing Office, 1927.) Price 10 cents.

Les Aleurites Producteurs d'Huiles siccatives " dites " Huiles de Bois. By É. Perrot and Mme. Yv. Khouvine. *Notice No.* 2, *Travaux de l'Association " Colonies-Sciences "* (Sous-Commission L.). Pp. 50, 9½ × 6½. (Paris: 44 Rue Blanche, 1926.) Price 15 frs.

L' " Aoura " palmier oléifère de Guyane (*cont.*). Exploitation et Avenir économique. *Bull. Ag. Gén. des Col.* (1927, **20**, 73–77).

Value of Fiji Copra. By J. D. Tothill, Superintendent of Agriculture. *Council Paper* No. 3, 1927, *Legislative Council, Fiji.* Pp. 4, 13 × 8½. (Suva: Government Printer, 1927.)

Pests and Diseases of Coconuts in the North-Western Province [Ceylon]. By C. N. E. J. de Mel. *Trop. Agric., Ceylon* (1927, **68**, 252–256).

An Investigation of some Problems of the Nigerian Groundnut Trade. By A. C. Barnes. *Fifth Ann. Rept., Dept. Agric., Nigeria,* 1926, pp. 50–71.

Contribution à la sélection des arachides à Madagascar. By M. Delpon. *Bull. Écon. Madagascar,* Nouv. Sér., No. 6, 1926, pp. 39–51.

Effect of Planting Distances and Time of Shelling Seed on Peanut Fields. By J. H. Beattie, C. J. Hunn, F. E. Miller, R. E. Currin and E. D. Kyzer. *Dept. Bull. No.* 1478, *U.S. Dept. Agric.* Pp. 11, 9 × 56. (Washington: Government Printing Office, 1927.) Price 5 cents.

De Invloed van de Voorvrucht op het Optreden van Slijmziekte (*Bacterium solanacearum*) in *Arachis hypogea* en Eenige andere Gewassen. By M. B. Schwarz. With Summary by C. Hartley. *Med. van het Inst. voor Plantenziekten No.* 71, *Dept. van Landbouw, Ned. Ind.* Pp. 37, 9½ × 6½. (Weltevreden: Landsdrukkerij, 1926.) Price fl. 0.75.

Measures for Increasing Production of Palm Fruit in Nigeria. By O. T. Faulkner. *Fifth Ann. Bull., Dept. Agric., Nigeria,* 1926, pp. 3–16.

The Recovery of Palm Kernels. By A. C. Barnes. *Fifth Ann. Bull., Dept. Agric., Nigeria,* 1926, pp. 24–32.

An Improved Process for the Extraction of Palm Oil by Natives.

The "Cooker-Press" Process. By A. C. Barnes. *Fifth Ann. Bull., Dept. Agric., Nigeria*, 1926, pp. 33–49.

Les Concasseurs à Noix de Palme. By G. Pesselègue. Préface by M. Ringelmann. Introduction by Ém. Prudhomme. *Bibliothèque de l'Institut National d'Agronomie Coloniale.* Pp. 162, 10 × 6½. (Paris: Émile Larose, 1927.)

Le Traitement mécanique des Fruits du Palmier à Huile. Exposition et Congrés de l'Institut Colonial de Marseille, Juin 27—Juillet 30, 1926. By A. Stieltjès. *Bull. Matières Grasses, Inst. Col., Marseille* (1926, Nos. 10–11–12, pp. 255–258).

L'Avenir du Palmier à Huile. By M. Ferrand. *Bull. Matières Grasses, Inst. Col., Marseille* (1927, No. 1, pp. 3–13).

La Sélection des Palmiers à Huile à la Station expérimentale de La Mé (*cont.*). By A. Houard. *Bull. Ag. Gén. des Col.* (1926, **19**, 1443–1452; 1927, **20**, 21–33).

Resultats des essais de germination des graines d'Elaeis effectués en 1922 et au début de 1923. By L. Castelli. *Agron. Colon.* (1927, **16**, No. 109, 13–18).

Olivicoltura nella Tunisia e nella Libia (*cont.*). By A. Maugini. *Agricolt. Colon.* (1927, **21**, 46–59; 83–94).

Essais divers sur le Beurre de Karité. By G. de Belsunce. (9) Procédé de raffinage du Karité par emploi d'un mélange oxydant. (10) Neutralisation du Beurre de Karité. *Bull. Matières Grasses, Inst. Col., Marseille* (1927, No. 1, pp. 14–19).

Étude sur le Karité. By P. Ammann. *Bull. Matières Grasses, Inst. Col., Marseille* (1927, No. 1, pp. 20–36).

Essential Oils

Bericht von Schimmel & Co., über Ätherische Öle, Riechstoffe, usw. Pp. 298, 8¾ × 6¼. (Miltitz bei Leipzig: Schimmel & Co., 1927.)

The Germicidal Values of some Australian Essential Oils and their Pure Constituents, together with those for some Essential Oil Components and Synthetic Substances. Part IV. By A. R. Penfold and R. Grant. *Journ. and Proc., Roy. Soc., N.S.W.* (1926, **60**, 167–170).

Le Citronnelle en Afrique Equatoriale Française. By F. Raunier. *Parfum. Moderne* (1927, **20**, 64–69).

Over de bepaling van het z.g. "total-geraniolgehalte" in Java-citronellaolie en over het analytisch onderzoek van die olie in het algemeen. By A. Reclaire and D. B. Spoelstra. *Berichten van de afdeeling Handelsmuseum van de Kon. Vereeniging Koloniaal Instituut, No.* 31. Pp. 15, 8½ × 5½. (Amsterdam, 1927.) Reprinted from *Indische Mercuur*, March 2, 1927.

The Essential Oils of *Eriostemon Coxii*, Mueller, and *Phebalium dentatum*, Smith. By A. R. Penfold. *Journ. and Proc., Roy. Soc., N.S.W.* (1927, **60**, 331–344).

Notes on the Essential Oils from some Cultivated Eucalypts. Part I. By A. R. Penfold. *Journ. and Proc., Roy. Soc., N.S.W.* (1926, **60**, 55–59).

The Essential Oils of *Leptospermum lanigerum*, Smith. Part I. By A. R. Penfold. *Journ. and Proc., Roy. Soc., N.S.W.* (1926, **60**, 73–84).

The Essential Oils of Australian Menthas. I. *Mentha satureiodes.* By T. G. H. Jones and F. Berry-Smith. *Proc. Roy. Soc. Queensland* for 1925, vol. xxxvii, pp. 89–91.

Michelia Champaca. By R. Cerbelaud. *Parfum. Moderne* (1927, **20**, 98–102).

Les Roses à Parfum. By C. Henry. *Bull. Ag. Gén. des Col.* (1926, **19**, 1415–1420).

The Essential Oil of *Zieria macrophylla*, Bonpland, and the Presence of a New Cyclic Ketone. By A. R. Penfold. *Journ. and Proc., Roy. Soc., N.S.W.* (1926, **60**, 104–112).

Fibres

Relatorio sôbre as experiências realizadas nas concessões do Gola Luige de 1923 a 1925. By F. Meinhardt. *Missão do Alegodão e Fibras Fomento Geral de Angola, Publ. Div. VI.* Pp. 21, 9 × 6. (Lisbon: Agência Geral das Colónias.)

Brasilianische Faserpflanzen nach Proben, gesammelt von L. Scholz, 1921. By F. Tobler and R. Schwede. *Faserforschung* (1927, **6**, 18–38).

Broom Millet. *Queensland Agric. Journ.* (1927, **27**, 111–119).

Calotropis (Akon) als Textilpflanze. By Fr. Tobler. *Faserforschung* (1927, **6**, 40–41).

Kenaf [*Hibiscus cannabinus*] und Kendir [*Apocynum venetum*]. By R. Schwede. *Faserforschung* (1927, **6**, 13–18).

Kendir [*Apocynum venetum*] in Wahrheit und Dichtung. By A. G. Jaeger. *Faserforschung* (1927, **6**, 6–12).

Struppiger Flachs. By Fr. Tobler. *Faserforschung* (1927, **6**, 1–6).

Flax Rust and its Control. By A. W. Henry. *Tech. Bull.* **36**, *Minnesota Agric. Exper. Sta.* Pp. 20, 9 × 6. (St. Paul, Minnesota: University Farm, 1926.)

Overzicht van de Dierlijke Vijanden van de Kapokcultuur op Java. By J. C. van der Meer Mohr. *Bull. No. 21, Inst. voor Plantenziekten, Dept. van Landbouw, Ned. Ind.* Pp. 33, 9½ × 6¼. (Soerabaja: H. van Ingen.)

Deterioration of Abacá (Manila Hemp) Fiber through Mold Action. By F. B. Serrano. *Philippine Journ. Sci.* (1927, **32**, 75–101).

Valeur textile de la filasse d' " Okon " (*Triumfetta cordifolia*) du Cameroun. By F. Heim de Balsac, J. Maheu, G. S. Dagand, O. Rœhrich and H. Heim de Balsac. *Bull. Ag. Gén. des Col.* (1926, **19**, 1453–1471).

L'Élevage du ver à soie. By P. Braemer. *Services Agricoles du Tonkin.* Pp. 96, 8½ × 5½. (Hanoi: Imprimerie d'Extrême-Orient, 1926.)

Report of Sericultural Work, Burma, for the Year ended June 30, 1926. Pp. 8, 9¾ × 6½. (Rangoon: Superintendent, Government Printing, 1927.) Price As.4 (5*d*.).

Recherches sur un Oïdium du Murier. By M. Ressencourt. *Bull. Écon. Indochine* (1927, **30**, N.S., 41–62).

South American Wools. By H. Kenningham. *Journ. Textile Inst.* (1927, **18**, T81–98).

Cotton

Twenty-second Annual Report of the British Cotton Growing Association for the Twelve Months ending December 31, 1926. *Public. No.* 97. Pp. 62, 8½ × 5½. (Manchester: British Cotton Growing Association, 1927.) Price 6*d*.

Empire Cotton Growing Corporation. Reports Received from Experiment Stations, 1925–26. Pp. 234, 9¼ × 6. (London: Empire Cotton Growing Corporation, 1927.) Price 2*s*. 6*d*.

Cotton-Growing in Cyprus. By C. Noble. *Emp. Cotton Growing Rev.* (1927, **4**, 103–104).

India's Cotton Problem. By H. A. F. Lindsay. *Asiatic Rev.* (1927, **23**, 266–284).

Recent Progress in Cotton Growing in India. By B. C. Burt. *Emp. Cotton Growing Rev.* (1927, **4**, 93–102).

Maintenance of Purity of the Improved Cottons. By Rama Prasada. *Dept. Agric., United Provinces, India.* Pp. 14, 9¾ × 6¼. (Allahabad: Superintendent, Government Press, 1927.) Price As.2.

A Note on the Improvement of American Cotton in Northern Nigeria. By J. K. Mayo. *Fifth Ann. Rept., Dept. Agric., Nigeria,* 1926, pp. 72–76.

Cotton-Growing in Northern Rhodesia—Report for the Season 1925–26. By E. F. Salter. *Emp. Cotton Growing Rev.* (1927, **4**, 118–120).

Cotton-Growing in Southern Rhodesia—Report for the Season 1925–26. By G. S. Cameron. *Emp. Cotton Growing Rev.* (1927, **4**, 121–129).

Cotton Experiments 1925–26, Serere Experiment Station, Uganda. *Circ. No.* 16, *Dept. Agric., Uganda.* Pp. 28, 9½ × 6. (Kampala: Department of Agriculture, 1926.)

Cotton-Growing in Fiji—First Progress Report for the Season 1925–26. By R. R. Anson. *Emp. Cotton Growing Rev.* (1927, **4**, 105–117).

Callide Cotton Research Station, Biloela. Annual Report for the Year ending June 30, 1926. *Queensland Agric. Journ.* (1927, **27**, 191–212).

La Culture du Cotonnier au Queensland. By R. C.-P. Boone. *Coton et Cult. Cotonnière* (1927, **2**, 8–11).

Étude technologique de Cotons de Perse. By Heim de Balsac, O. Rœhrich and Ch. Pontillon. *Trav. de la Sect. des Cotons, Coton et Cult. Cotonnière,* (1927, **2**, 13–20).

Report on Cottons from Siam. By Sir George Watt. *Tech. and Sci. Suppl. No.* 2 *to The Record.* Pp. 6, 12 × 8¾. (Bangkok, Siam: Ministry of Commerce and Communications, 1926.) Price 50 Satangs.

La Culture du Cotonnier en Syrie. By E. Achard. *Coton et Culture Cotonnière* (1926, **1**, 91–115).

Étude technologique de Cotons d'Algérie. By Heim de Balsac, O. Rœhrich and Ch. Pontillon. *Trav. de la Sect. des Cotons, Coton et Culture Cotonnière* (1926, **1**, 125–162).

The Development of the Egyptian Cotton Plant. By M. A. Bailey and T. Trought. *Bull. No.* 60, *Tech. and Sci. Serv., Min. Agric., Egypt.* Pp. 46, 10¾ × 7½. (Cairo: Government Press, 1926.) Price P.T.5.

La Production en Grand des Semences Pures de Cotonnier en Égypte. By M. Greiss Bey. *Coton et Culture Cotonnière* (1926, **1**, 123–124).

Note sur la variété de Coton Égyptien "Zagora." By R.-H. Lucky. *Coton et Culture Cotonnière* (1926, **1**, 117–122).

Le Coton à Madagascar. By V. Cayla. *Agron. Colon.* (1927, **16**, No. 109, 1–12; No. 110, 57–60).

Étude technologique de Cotons de Tunisie (*cont.*). By Heim de Balsac, O. Rœhrich and Ch. Pontillon. *Trav. de la Sect. des Cotons, Coton et Cult. Cotonnière* (1927, **2**, 1–12).

O Algodão no Ceará e os meios empregados para o seu desenvolvimento. By C. G. C. Bolland. *Bol. do Minist. da Agric., Rio de Janeiro* (1927, **16**, 39–57).

Notas sobre la Producción de Algodón en Cuba. By S. C. Bruner. *Rev. de Agric., Cuba* (1927, **8**, No. 5, 3–5).

Growth and Development of Cotton Plants at Greenville, Tex. By H. C. McNamara, J. W. Hubbard and R. E. Beckett. *Dept. Circ. No.* 401, *U.S. Dept. Agric.* Pp. 17, 9 × 6. (Washington: Government Printing Office, 1927.) Price 5 cents.

La Culture du Coton en Nouvelle-Calédonie. By M. Etesse. *Coton et Cult. Cotonnière* (1927, **2**, 1–7).

Cotton Prices and Markets. By A. B. Cox. *Dept. Bull. No.* 1444, *U.S. Dept. Agric.* Pp. 77, 9 × 6. (Washington: Government Printing Office, 1926.) Price 15 cents.

Services in Cotton Marketing. By A. B. Cox. *Dept. Bull. No.* 1445, *U.S. Dept. Agric.* Pp. 39, 9 × 6. (Washington: Government Printing Office, 1926.) Price 10 cents.

Méthode d'Appréciation commerciale du Coton en Laine à l'Usine d'Égrenage. By L. Joly. *Coton et Culture Cotonnière* (1926, **1**, 125–136).

Détermination de la Proportion des Fibres mortes d'un Coton par Teinture à l'Indigo. By Heim de Balsac, O. Rœhrich and J. Rolland. *Trav. de la Sect. des Cotons, Coton et Culture Cotonnière* (1926, **1**, 113–117).

Schaden und Bekämpfung der Baumwollwanzen. By H. Morstatt. *Tropenpflanzer* (1927, **30**, 150–155).

Some Insects Associated with Cotton in Papua and the Mandated Territory of New Guinea. By E. Ballard. *Bull. Entom. Res.* (1927, **17**, 295–300).

The South American Boll-worm of Cotton (*Sacododes pyralis*, Dyar). By C. L. Withycombe. *Bull. Entom. Res.* (1927, **17**, 265–271).

The Mexican Cotton Boll Weevil. By W. Newell, E. F. Grossman and A. F. Camp. *Bull.* 180, *Florida Agric. Exper. Sta.* Pp. 27, 9 × 6. (Gainesville, Florida: Agricultural Experiment Station, 1926.)

Fungoid Diseases of Cotton in Southern Nigeria. By T. Laycock. *Fifth Ann. Bull., Dept. Agric., Nigeria,* 1926, pp. 17–23.

The Occurrence of Angular Leaf-Spot of Cotton (*Bacterium malvacearum*) in Uganda. By J. D. Snowden. *Circ. No.* 17, *Dept. Agric., Uganda.* Pp. 3–12, 9¾ × 6¼. (Kampala: Department of Agriculture, 1926.)

Efforts to Determine the Means by which the Cotton-Wilt Fungus, *Fusarium vasinfectum,* induces Wilting. By H. R. Rosen. *Journ. Agric. Res.* (1926, **33**, 1143–1162).

Notes sur le "Wilt," maladie du Cotonnier en Égypte. By R.-H. Lucky. *Coton et Cult. Cotonnière* (1927, **2**, 12–17).

Paper-making Materials

Valeur papetière des feuilles de "Cay la Buong" (Latanier) d'Indochine (Annam)—*Corypha laevis.* By F. Heim de Balsac, A. Deforge, G. S. Dagand, J. Maheu and H. Heim de Balsac. *Bull. Ag. Gén. des Col.* (1927, **20**, 51–64).

Fungi in Wood Pulp. By S. Samuelsen. *World's Paper Trade Review* (1927, **87**, 702–711). Translated from *Papır-Journalen.*

Rubber

Rubber in Burma. Pp. 32, 9¾ × 6¼. (Issued by the Government of Burma, 1926.)

The Hevea Rubber Tree in the Amazon Valley. By C. D. la Rue. *Dept. Bull. No.* 1422, *U.S. Dept. Agric.* Pp. 69, 9 × 6. (Washington: Government Printing Office, 1926.) Price 15 cents.

Rubber and Textiles. Being a short account of the preparation and properties of rubber with particular reference to its uses in the textile industry. Pp. 30, 8½ × 5½. (London: Rubber Growers' Association, Inc., 1927.) Gratis.

Importance of Bark Examination in the Selection of Prospective Mother Trees. By R. A. Taylor. *Trop. Agric., Ceylon* (1927, **68**, 245–247).

Note sur la sélection de l'hévéa aux Indes Néerlandaises. By Y. Henry. *Bull. Écon., Indochine, Nouv. Sér., Renseignements* (Dec. 1926, pp. 759–782).

Superieur Plantmateriaal bij *Hevea brasiliensis* in Besoeki. By J. Schweizer. *Arch. Rubbercult.* (1927, **11**, 83–98; summary in English, pp. 99–104).

Bud-grafting of Rubber Trees. Union of Stock and Scion. By F. G. Spring. *Malayan Agric. Journ.* (1927, **15**, 21–23).

Rubber verkregen van Oculatie's. II. Onderzoek van latex en rubber van eenige Cultuurtuincloonen en hun moederboomen. By O.

de Vries and W. Spoon. *Arch. Rubbercult.* (1927, **11**, 112–145; summary in English, pp. 146–149).

Contribution à l'Étude de la Coagulation des Latex Caoutchoucifères—Valeur industrielle des gommes obtenues par l'emploi de divers coagulants. By F. Heim de Balsac, C. Chéneveau, R. Audubert and A. Parveaud. *Bull. Ag. Gén. des. Col.* (1927, **20**, 65–72).

Latex en Rubber van jonge Boomen. By R. Riebl. *Arch. Rubbercult.* (1927, **11**, 155–165; summary in English, pp. 166–168).

The Rubber Content of Ammoniated Latex. By R. O. Bishop. *Malayan Agric. Journ.* (1927, **15**, 1–11).

Studies on Hevea Latex. VI. The Proteins in Serum from Frozen Latex. By R. O. Bishop. *Malayan Agric. Journ.* (1927, **15**, 27–34).

Études Physico-chimiques sur les Latex caoutchoucifères. Relations entre la concentration des latex, celle des agents de coagulation, la présence des protéines, et le mécanisme de la coagulation. By F. Heim de Balsac, R. Audubert and G. Lejeune. *Bull. Ag. Gén. des Col.* (1926, **19**, 1472–1479).

Onderzoekingen over balrubber (Rubber bereid volgens on Braziliansche methode). By O. de Vries and W. Spoon. *Arch. Rubbercult.* (1927, **11**, 1–44; summary in English, pp. 45–65).

The Ageing Properties of Raw and Vulcanised Rubber. By G. Martin. *Transactions, Institute of the Rubber Industry* (1927, **2**, 354–380).

Natural Immunity of Rubber Trees to Bark Rot. By R. H. Stoughton-Harris. *Trop. Agric., Ceylon* (1927, **68**, 143–145).

Brown Bast of Rubber and its Treatment. By J. Mitchell. *Trop. Agric., Ceylon* (1927, **68**, 239–244).

Rot of Hevea Cortex in Uganda. By J. D. Snowden. *Circ. No.* 17, *Dept. Agric., Uganda.* Pp. 13–22, $9\frac{3}{4} \times 6\frac{1}{4}$. (Kampala: Department of Agriculture, 1926.)

Further Work on Treatment of "Wet-Root Rot." By A. Sharples. *Malayan Agric. Journ.* (1927, **15**, 35–40).

Tobacco

Tobacco Cultivation. By J. S. Dash. *Proc. Agric. Soc. Trinidad* (1927, **27**, 1–13).

Zur Methodik der Tabakfermentation. By W. Busse. *Tropenpflanzer* (1927, **30**, 94–112).

Der Bau von Virginia-Tabak in Süd-Rhodesien. By A. v. Hirschfeld. *Tropenpflanzer* (1927, **30**, 135–150).

Tobacco-growing in South-western Ontario. A summary of ten years of experiment at the Dominion Experimental Station, Harrow, Ontario. By D. D. Digges. *Bull.* 76, *New Ser., Dept. Agric., Canada.* Pp. 29, $9\frac{3}{4} \times 6\frac{1}{4}$. (Ottawa: Minister of Agriculture, 1927.)

La Culture du Tabac en Indochine. By M. Lagleyze. *Bull. Econ. Indochine* (1927, **30**, N.S., 1–40).

A Phytophthora Disease of Tobacco. By W. B. Tisdale and J. G. Kelley. *Bull.* 179, *Florida Agric. Exper. Sta.* Pp. 63, 9×6. (Gainesville, Florida: Agricultural Experiment Station, 1926.)

Stem Injury of Tobacco caused by Fungi Growing on the Poison Mixture Used for Controlling Budworms. By W. B. Tisdale and J. G. Kelley. *Bull.* 182, *Florida Agric. Exper. Sta.* Pp. 10, 9×6. (Gainesville, Florida: Agricultural Experiment Station, 1926.)

Drugs

Bacterial Leaf Spot of Betel. By C. Ragunathan. Pp. 2, $10 \times 6\frac{1}{4}$. (Colombo: Government Printer, 1926.) Price 5 cents.

Quinquina et Quinine. By É. Perrot. *Notice No.* 20, *Office*

National des Matières Premières végétales pour la Droguerie et la Parfumerie, Ministère du Commerce et de l'Industrie. Pp. 174, $9\frac{1}{2} \times 6\frac{1}{4}$. (Paris: 12 Avenue du Maine, 1926.) Price 25 frs.

Administration Report of the Government Cinchona Department, Madras, for 1925–26. Pp. 25, $13 \times 8\frac{1}{4}$. (Government of Madras, Development Department, 1927.)

A Pharmacognostical Study on *Datura alba*, Nees, and *D. fastuosa*, Linn., from the Philippines. By J. K. Santos. *Philippine Journ. Sci.* (1927, **32**, 275–296).

Contribution à l'Étude du *Dirca palustris*, Linn., ou "Bois de Plomb." By L. Choquette, *Trav. Lab. Mat. Méd. de la Faculté de Pharmacie de Paris*, Vol. xvii, 1926, Part iv, pp. 93.

Monographie du Peyotl (*Echinocactus Williamsii*, Lam.). By A. Rouhier. *Trav. Lab. Mat. Méd. de la Faculté de Pharmacie de Paris*, Vol. xvii, 1926, Part v, pp. 371.

The Toxic Principle of *Erythrophlœum lasianthum*. By P. Kamerman. *S. African Journ. Sci.* (1926, **23**, 179–184).

Hydnocarpus and Taraktogenos in the Federated Malay States. By B. Bunting and J. N. Milsum. *Kew Bull.* (1927, No. 2, pp. 49–56).

Le Chrysanthème Insecticide (Pyrèthre). Ses préparations, substitutions et falsifications. By É. Perrot. *Trav. Lab. Mat. Méd. de la Faculté de Pharmacie de Paris*, Vol. xvii, 1926, Part vi, pp. 8.

Miscellaneous Agricultural Products

Notes sur les graines de *Coix* dites "Larmes de Job." By C. Crevost. *Bull. Écon., Indochine, Nouv. Sér., Renseignements* (Dec. 1926, pp. 754–756).

The Institute of Brewing Research Scheme. Fourth Report on the Experiments on the Influence of Soil, Season and Manuring on the Quality and Growth of Barley, 1925. By Sir E. J. Russell. *Journ. Inst. Brewing* (1927, **33** (**24**, N.S.), 104–110).

The Institute of Brewing Research Scheme. Fourth Report of the Influence of Soil, Season and Manuring on the Quality and Growth of Barley of the 1925 Crop as Indicated by the Malts made therefrom. By H. M. Lancaster. With Appendix on Malting Results, by H. M. Lancaster and on Analytical Results, by H. L. C. Hind. *Journ. Inst. Brewing* (1927, **33** (**24**, N.S.) 111–119).

The Institute of Brewing Research Scheme. The Strength of Yeast Cells. By S. B. Schryver, E. T. Thomas and S. G. Paine. *Journ. Inst. Brewing* (1927, **33** (**24**, N.S.), 120–137).

Institute of Brewing Research Scheme. Report on Manuring Experiments on Hops, 1925. By A. H. Burgess. *Journ. Inst. Brewing* (1927, **33** (**24**, N.S.), 138–140).

The Downy Mildew of the Hop in 1926. By E. S. Salmon and W. M. Ware. *Journ. Min. Agric.* (1927, **33**, 1108–1121).

Forestry

General

Progress Report of Forest Research Work in India, 1925–1926. Including the Administration Report of the Forest Research Institute, Dehra Dun. Pp. 143, $9\frac{1}{2} \times 6\frac{1}{4}$. (Calcutta: Government of India Central Publication Branch, 1927.) Price Rs.2, As.14 (5*s*.).

Annual Return of Statistics relating to Forest Administration in British India for the Year 1924–25. Pp. 31, $13 \times 8\frac{1}{4}$. (Calcutta: Government of India Central Publication Branch, 1926.) Price Rs.4, As.2 (5*s*.).

Indian Forest Administration. By W. F. Perrée. *Asiatic Rev.* (1927, **23**, 241–265).

Annual Progress Report of the Administration in Ajmer-Merwara Forests for the Year 1925–26. Pp. 32, 9¾ × 6¼. (Calcutta: Government of India Central Publication Branch, 1927.) Price Rs.2, As.3 (4s. 6d.).

Report of Forest Administration in Baluchistan for the Year 1925–26. Pp. 32, 9½ × 6½. (Calcutta: Government of India Central Publication Branch, 1926.) Price Rs.4, As.4 (7s. 3d.).

Annual Progress Report on Forest Administration in the Presidency of Bengal for the Year 1925–26. Pp. 45 + 2, 13 × 8¼. (Calcutta: Bengal Secretariat Book Depot, 1926.) Price Rs.2, As.10 (4s. 9d.).

Annual Progress Report on Forest Administration in the Province of Bihar and Orissa for the Year 1925–26. Pp. 71 + 3, 13 × 8¼. (Patna: Superintendent, Government Printing, Bihar and Orissa, 1926.) Price Rs.3, As.4.

Report on the Forest Administration in Burma for the Year ending March 31, 1926. Pp. 217, 9¾ × 6¼. (Rangoon: Superintendent, Government Printing, 1927.) Price Rs. 6 (8s.).

Annual Report on Working Plans and Silviculture in Burma, 1925–26. Pp. 67, 9¾ × 7½. (Rangoon: Superintendent, Government Printing, 1927.) Price Rs.2.

Progress Report of Forest Administration in Coorg for 1925–1926. Pp. 14 + 17, 13 × 8¼. (Bangalore: Mysore Residency Press, 1926.) Price R.1.

Administration Report of the Forest Department of the Madras Presidency for the Year ending March 31, 1926. Vol. I. Pp. 159, 9¾ × 6¼. Vol. II. Pp. 172, 9¾ × 6¼. (Madras: Superintendent, Government Press, 1927.) Price Vol. I, As.12; Vol. II, As.8.

Report of the Forest Department, Union of South Africa, for the Year ended March 31, 1926. Pp. 32, 9½ × 6. (Pretoria: Government Printing Office, 1927.)

A Review of the Species of *Populus* introduced into South Africa. By C. S. Hubbard. *S. African Journ. Sci.* (1926, **23**, 340–365).

General Biology of the Flowers, Fruits and Young Regeneration of the more Important Species of the Knysna Forests. (A Summary of preliminary studies). By J. F. V. Phillips. *S. African Journ. Sci.* (1926, **23**, 366–417).

Trees and Shrubs of Southern Rhodesia, Part II. By E. C. Steedman. *Proc. Rhodesia Sci. Assoc.* (1926–27, **26**, 1–39).

Report by the Conservator of Forests on the Valuation of the Forests of the Bartica-Kaburi Area, British Guiana. *Combined Court* No. 40, 1926. Pp. 25, 13 × 8¼. (Georgetown: "The Argosy" Company, Ltd., 1926.)

The Stringybark Belt of Western Victoria. By A. H. Hore. *Austr. For. Journ.* (1926, **9**, 266–268).

Annual Report of the Director of Forestry, State Forest Service, New Zealand, for the year ended March 31, 1926. Pp. 39, 13 × 8¼. (Wellington: Government Printer, 1926.)

Annual Report of the Director of Forestry of the Philippine Islands for the Fiscal Year ended December 31, 1925. Pp. 227, 9 × 6. (Manila: Bureau of Printing, 1926.)

La selvicoltura in Tripolitania. Note de Viaggio. By A. Pavari. *L'Agricolt. Col.* (1927, **21**, 121–135).

Onderzoek naar bruikbare kenmarken ter identificatie van boomen naar hun bast. By A. Thorenaar. *Med. Proefsta. voor Boschwezen*, No. 16, *Dept. van Landb., Ned. Ind.* Pp. 207 + Platenatlas of 60 figures, 10¾ × 7¼. (Wageningen: H. Veenan en Zonen, 1926.)

The Propagation of "Stinkwood" (*Ocotea bullata*) by Vegetative Means. By J. F. V. Phillips. *S. African Journ. Sci.* (1926, **23**, 418–434).

Pinus patula, Schl. and Cham., Its Introduction into and Growth in South Africa. By J. J. Kotze. *S. African Journ. Sci.* (1926, **23**, 455–466).

Loblolly Pine Primer. By W. R. Mattoon. *Farmer's Bull. No.* 1517, *U.S. Dept. Agric.* Pp. 38, 9 × 6. (Washington: Government Printing Office, 1926.) Price 10 cents.

Virgilia capensis, Lamk. ("Keurboom"): A Contribution to its Ecology and Sylviculture. By J. F. V. Phillips. *S. African Journ. Sci.* (1926, **23**, 435–454).

Hoplocerambyx spinicornis—An Important Pest of Sal. By D. J. Atkinson. *Forest Bull. No.* 70 (*Entom. Ser.*). Pp. 14 + 5 plates, 9¾ × 6½. (Calcutta: Government of India Central Publication Branch, 1927.) Price As.15 (1*s*. 6*d*.).

The Spruce Gall-Aphid. By G. W. Herrick and T. Tanaka. *Bull.* 454, *Cornell Agric. Exper Sta.* Pp. 17, 9 × 6. (Ithaca, New York: Cornell University, 1926.)

Timbers

Constructional Timbers: Their Characteristics and Uses. By J. L. Crawford. *Timber News*, Jan. 21, 1927, pp, 11–13. (Report of a lecture held under the joint auspices of the Liverpool Timber Trade Assoc., Ltd., and the Liverpool University Extension Board.)

The Preservative Treatment of Wood, with Special Reference to Absorption. By E. F. English. *S. African Journ. Sci.* (1926, **23**, 472–477).

Preliminary Notes on the Seasoning of Native Timbers [of Trinidad]. *Leaflet No.* 2, *For. Dept., Trinidad and Tobago.* Pp. 16, 8½ × 5½. (Trinidad: Government Printer, 1926.)

Notes on the Comparative Economic Cost of Wood and Metal Sleepers in India, and Cost of Treatment. By J. H. Warr and H. Trotter. *For. Bull. No.* 68 (*Econ. Ser.*). Pp. ii + 29, 9¾ × 7½. (Calcutta: Government of India Central Publication Branch, 1927.) Price R.1, As.12 (3*s*.).

Specific Gravity Studies of South African grown Timber. By M. H. Scott. *S. African Journ. Sci.* (1926, **23**, 478–485).

Philippine Woods. By W. E. McKee. *Timber News*, March 18, 1927, pp. 15–17; March 25, 1927, pp. 17–18.

Notes sur les Bois de Madagascar. Les Rotra (*Eugenia* spp.). By M. Louvel. *Bull. Écon., Madagascar* (1926, No. 1, pp. 116–126).

Utilization of Dogwood and Persimmon. By J. B. Cuno. *Dept. Bull. No.* 1436, *U.S. Dept. Agric.* Pp. 42, 9 × 6. (Washington: Government Printing Office, 1926.) Price 15 cents.

The Properties and Uses of Insignis Pine (*Pinus radiata*). By A. R. Entrican. *Austr. For. Journ.* (1926, **9**, 261–263).

Report on the Physical and Mechanical Properties of *Pinus patula*. By N. B. Eckbo. *S. African Journ. Sci.* (1926, **23**, 467–471).

The Mechanical and Physical Properties of Himalayan Spruce and Silver Fir. By L. N. Seaman and C. R. Ranganathan. *Forest Bull. No.* 69, *For. Res. Inst., Dehra Dun.* Pp. 26, 9¾ × 7½. (Calcutta: Government of India Central Publication Branch, 1926.) Price Rs.1, As.1 (1*s*. 9*d*.).

Tanning Materials

Ueber Urunday (*Astronium balansae*) und Urundayextrakt. *Collegium* (1926, No. 680, 535–541).

I bacelli di Sappan come materiale per concia e per tinta. By F. Vignolo-Lutati and M. Chiera. *Boll. Uffic., R. Stazione Sperimentale per l'Industria delle Pelli e delle Materie Concianti, Napoli-Torino* (1926, **4**, 337–343).

Gums and Resins

Elemi—the Oleo-resin of *Canarium Muelleri*. By T. G. H. Jones and F. Berry-Smith. *Proc. Roy. Soc. Queensland* for 1925, vol. xxxvii, pp. 92–97.

Nieuwe onderzoekingen over Perubalsem uit onze Koloniën. *Berichten van de afdeeling Handelsmuseum van de Kon. Vereeniging Koloniaal Instituut, No.* 30. Pp. 20, 8½ × 5½. (Amsterdam, 1927.) Reprinted from *Indische Mercuur*, Feb. 23, 1927.

NOTICES OF RECENT LITERATURE

Canada as a National Property. Pp. 75, 10 × 8. (Ottawa: Natural Resources Intelligence Service, Department of the Interior, 1926.)

This is a well printed and attractively produced official publication, which in a small space sets out in an interesting manner the chief industrial and topographical features and the economic resources of the Dominion. It can be recommended to intending visitors or settlers as a very useful and informative handbook.

Cotton: History, Species, Varieties, Morphology, Breeding, Culture, Diseases, Marketing, and Uses. By Harry Bates Brown, A.M., Ph.D. Pp. xi + 517, 9½ × 6½. (London: McGraw-Hill Publishing Co., Ltd., 1927.) Price 25*s*.

This book gives a comprehensive account of cotton and its cultivation. After a brief historical survey of the subject, the author proceeds to give a detailed account of the cotton plant in respect of its botanical species, agricultural varieties, morphology, physiology, reproduction and heredity. This is followed by a discussion of various matters relating to the cultivation and production of cotton, including cotton selection and breeding, manures, rotations, soils, climate, ploughing, planting, diseases and pests, harvesting and ginning. Incidentally it may be mentioned that the chapter on cotton harvesting contains the best account we have yet seen of the various classes of machines which have been devised for cotton-picking. An account is given of cotton grading and marketing, including particulars of the cotton exchanges and their functions, and the work concludes with a number of chapters relating to the economics of cotton seed products and oil mill processes, the uses and spinning qualities of various kinds of cotton, the manufacture of cotton yarns and cloths, and a collection of statistics relating to production, consumption, exports and imports of cotton in the United States.

The information supplied in this volume relates almost entirely to the American cotton belt and especially to the Upland cotton districts, comparatively little reference being made to cotton produced in other countries. The book is well written and contains a large number of excellent illustrations, and its value is enhanced by the list of references to published work appended to each chapter.

A MANUAL OF THE PROCESSES OF WINDING, WARPING AND QUILLING OF SILK AND OTHER VARIOUS YARNS FROM THE SKEIN TO THE LOOM. By Samuel Kline. Second Edition. Pp. ix + 155, 8¼ × 5¼. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1926.) Price 10s.

This little book, the scope of which is clearly indicated in its title, should prove of value to the practical textile worker. In this new edition a chapter has been added which deals in detail with the various defects and difficulties encountered in the warping and weaving of silk yarns. There are a number of illustrations of machines employed in the processes dealt with and a useful glossary of technical terms relating to warping, winding, quilling, etc.

QUINQUINA ET QUININE. By M. Émile Perrot. Ministère du Commerce et de l'Industrie. Office National des Matières Premières végétales pour la Droguerie et la Parfumerie. Notice No. 20 (Juillet 1926). Pp. 174, 9¼ × 6. (Paris: Presses Universitaires de France; 49 Boul. Saint-Michel, V^{e}.) Price 25 francs.

This monograph is divided into four parts, the first of which deals with the discovery of cinchona in South America, the various indigenous varieties, their distribution, and the characters of those barks that enter commerce. The second part contains an account of the general chemical and microscopical characters of cinchona bark and a short description of the pharmacology of quinine. The third and largest part of the work is devoted to the introduction of cinchona into other parts of the world, the cultivation, harvesting and preparation of the bark, and its present position in commerce. Statistics are given relating to the estimated cost of production on a Java plantation, and to the exports of bark from the Dutch East Indies. The final part of the monograph briefly describes the production of quinine and quinine sulphate, and discusses the Kina Bureau and the Cinchona Convention.

The Palms of British India and Ceylon. By Ethelbert Blatter, S.J., Ph.D., F.L.S. Pp. xxviii + 600, 10 × 6. (London: Humphrey Milford, Oxford University Press, 1926.) Price 45*s*.

The appearance in book form of Dr. Blatter's papers on the palms occurring in British India and Ceylon is most welcome. As is well known, Dr. Blatter contributed to the Journal of the Bombay Natural History Society during a period of some eight years (1910–1918) a series of papers, with illustrations, dealing with the palms growing in India and Ceylon. In the present work these papers have been corrected and amplified and brought up to date, and form a work which is a valuable addition to the literature of the palms. The classification adopted by the author is that of Professor Drude in the *Natürliche Pflanzenfamilien*, which system was selected in preference to that of Hooker's *Flora of British India* for practical reasons arising out of the circumstance that the plants to be dealt with comprised a large number of exotic species in addition to those indigenous in the countries in question. In the introduction Professor Blatter gives a short history of the exploration of the Indian palm flora, referring to the scarcity of information on the subject until the fruitful investigations of Griffith, who died in 1845. This section is followed by an account of the general morphology of palms and their geographical distribution, the occurrence of the family in India being dealt with in detail. Compared with tropical America, India and Ceylon are not rich in their palm flora, the total number of species hitherto described being about one hundred. The Burmese botanical region, as defined by Hooker, possesses the most abundant palm flora, seventy species (of which twenty-eight are endemic) being recorded. Ceylon has eleven endemic species of palms.

The plan of description adopted by the author comprises a brief systematic account of the essential characters of the tribes, sub-tribes and genera, followed by detailed particulars regarding the species. The latter information includes references to literature, a list of names in various languages, a full botanical description and notes on the uses of the palm; and, where possible, hints on the cultivation of the species. A most valuable feature of the book is the numerous series of excellent photographs with which it is illustrated. The author must have devoted much labour to the collection of these illustrations and it is to be regretted that the publishers did not see their way to printing them on paper which would have done full justice to such admirable pictures.

In a further edition the author would no doubt include a reference to the important planting of the West African oil palm in Sumatra and Malaya, and to the use which has been made of the nipa palm as a source of alcohol. The account of the uses of the West African wine palm (*Raphia vinifera*) might also include specific references to the preparation of West African piassava from the leaf stalks and of " raffia " from the cuticle of young leaves, products briefly mentioned in the introductory paragraph dealing with this species.

The book includes a valuable bibliography of the palms and has a good index.

Mikrographie des Holzes der auf Java Vorkommenden Baumarten. Bearbeitet von Dr. H. H. Jansonius. Vierter Band. Pp. 874, 9 × 5¾. (Leiden: E. J. Brill, Ltd., 1920–26.)

The previous volumes of this work have been noticed in this Bulletin (1912, **10**, 183, and 1921, **19**, 556). The present fourth volume comprises three parts which deal with the structure of the woods of species belonging to the following natural families: Part 6: Caprifoliaceæ, Rubiaceæ, Compositæ, Vacciniaceæ, Myrsineæ (introduction); Part 7: Myrsineæ (continued), Sapotaceæ, Ebenaceæ, Styraceæ, Oleaceæ, Apocynaceæ (introduction); Part 8: Apocynaceæ (continued), Loganiaceæ, Boragineæ, Scrophularineæ, Gesneraceæ, Bignoniaceæ, Verbenaceæ. In the two first-mentioned parts the plan of description follows that of preceding volumes, but it is observed that in part 8 an additional section dealing with the macroscopic characters of the timbers has been introduced, as a result (it would appear) of suggestions made to the author by a number of workers. The volume contains a full index.

Citrus Products. Part I. By James B. McNair. Pp. xii + 212, 9½ × 6½. *Field Museum of Natural History Publication* 238; *Botanical Series, Vol. VI, No.* 1. (Chicago: Field Museum of Natural History, 1926.)

The publication of which the present volume is the first part should be a useful companion to the books on citrus cultivation and citrus diseases which have recently been brought to the notice of readers of this Bulletin (1926, **24**, 720, 721). The intention of the author has been to provide a work of reference on the technology and economics of citrus products, his own observations and investigations being supplemented by a comprehensive summary of information from other sources.

Part I, consisting of ten chapters, gives accounts of the various citrus products, classified according to the parts of the plant from which they are derived.

The first products dealt with are those obtained from the fruit, including essential oils and pectin, with a brief chapter on dried, candied and preserved peel. The products from the pulp include principally fruit juices, fermented products, and citric acid. Two short chapters follow, one concerned with citrus seed oils and the other devoted principally to marmalade. The last three chapters, on products from the flowers, leaves and stems, deal with a number of essential oils.

The extensive use made by the author of published researches and other sources of information has resulted in a certain unevenness in the composition of the book and the inclusion of much that is mainly of theoretical interest, as for instance the review of researches that have been carried out on the production of citric acid by fermentation and by artificial synthesis. Nevertheless it will form a valuable addition to the growing library of citrus literature.

It is stated in the preface that the second part of the book will deal with methods of manufacture of citrus products in various countries, and the economics of the industry.

THE MICROBIOLOGY OF CELLULOSE, HEMICELLULOSES, PECTIN AND GUMS. By A. C. Thaysen and H. J. Bunker. Pp. viii + 363, $8\frac{1}{2} \times 5\frac{1}{2}$. (Oxford: The University Press; London: Humphrey Milford, 1927.) Price 25*s*.

This work is a valuable compendium of the facts at present known regarding the action of micro-organisms on the constituents of vegetable tissues described as cellulose, hemicelluloses, pectins and gums. In the preface the authors state that in their investigations on the microbiological destruction of cellulose they have often felt the need of a comprehensive account of the information available on this and the allied subjects of the microbiological changes occurring in hemicelluloses, pectins and gums, and that in the present treatise they have made an attempt to fill this gap and to give an outline of the more essential literature already in existence. They add that the treatise has been compiled from the point of view of the research worker who desires to know in what direction his efforts may most profitably be expended in connection with the subject of the natural and artificial decomposition of vegetable tissues, which is constantly increasing in theoretical and practical importance.

The work consists of four parts, the first of which gives a general account of the occurrence and properties of cellulose, hemicelluloses, pectin and gums, and indicates the various directions in which the question of the natural disposal of surplus vegetable matter has been investigated, and the importance of micro-organisms in maintaining the equilibrium of the carbon supply of nature. In the second part are described the various types of micro-organisms which are responsible for the decay of vegetable debris. The third part deals with the chemical decompositions resulting from the action of microbiological enzymes on the celluloses and other substances under discussion, and includes information on the retting of fibre plants, the preparation of starch by the fermentation of pectin, and the microbiological decomposition of hemicelluloses and cellulose in the manure heap, on the surface of the soil and in the soil, under water, and in the intestines of animals. Other subjects treated are the changes occurring in the preparation of silage, the spontaneous heating of hay, the fermentation of tobacco, and the fermentation of cocoa and coffee beans. One chapter is devoted to the decay of vegetable debris leading to the formation of peat and coal, and another with the action of micro-organisms on vegetable fibres and fabrics, including the "mildewing" effect, the "country damage" of cotton, the "heart damage" of jute, and similar phenomena. The destruction of wood and wood-pulp by micro-organisms is also considered. The fourth part of the book gives an account of the industrial applications of these microbiological reactions and discusses the production of combustible gases, power alcohol and organic acids from hemicelluloses and cellulose.

The volume will prove of much service to all workers concerned with the microbiological decompositions of cellulose and related substances, its value being greatly enhanced by the useful bibliography appended to each chapter.

Manual of Plant Diseases. By Frederick Deforest Heald, M.S., Ph.D. Pp. xiii + 891, 9¼ × 6¼. (London: McGraw-Hill Publishing Co., Ltd., 1926.) Price 35*s*.

The term disease is used by the author of this book in its widest sense. Not only are diseases of parasitic origin and virus diseases dealt with, but also those due to edaphic influences (such as deficiencies of food materials in the soil, excesses of soluble salts, and unfavourable water relations), to unsuitable air conditions, high or low temperatures, unfavourable light, as well as injuries

caused by pollution of the atmosphere, spraying solutions, etc.

The parasitic diseases dealt with are arranged according to the systematic positions of the causative organism, chapters being included on parasitic seed plants and nematodes. The plan of this section of the book is on somewhat different lines from those of most textbooks of plant diseases. Instead of brief particulars of a large number of diseases, certain typical examples are taken for detailed consideration, and the student is given a full list of references to others, from which he can obtain any desired information. The method is an admirable one, as it enables the author in the space available to deal in much more detail with the basic principles underlying disease in plants and thus guide the student towards a more rational mode of treatment.

The book is intended primarily for the agricultural student in the United States and diseases of most tropical crops consequently receive little or no consideration. Nevertheless it should be in the possession of all interested in the scientific study of plant diseases. As already indicated the references to literature are very full (particularly as regards American works), but a notable omission from the list of " the more important textbooks and manuals relating to plant diseases—English," which covers works on the whole subject, is Petch's *Diseases and Pests of the Rubber Tree*.

WORMS IN FURNITURE AND STRUCTURAL TIMBER. By John Girdwood. Pp. xi + 159, 8½ × 5½. (Oxford: University Press; London: Humphrey Milford, 1927.) Price 12*s*. 6*d*.

The author of this book, having occasion to preserve certain pieces of antique furniture from the ravages of the furniture beetle, carried out over a number of years a series of tests with turpentine, both alone and in admixture with paraffin oil, in order to ascertain its efficacy for the purpose. Although the experiments were admittedly not conducted on strictly scientific lines, the results as recorded in the present work are most interesting and, in the author's opinion, definitely prove that turpentine not only exterminates the pest, but causes no damage to the colour or polish of the furniture treated, if applied carefully, and if the piece is not handled unduly before the liquid has evaporated.

The reason that turpentine has sometimes failed to give satisfactory results is attributed to the fact that it has been used much too sparingly. Experiments with a

large number of pieces of wood showed that badly wormed wood, one inch thick, absorbed 18½ oz. of fluid per superficial foot, medium wormed wood 6½ oz., and sound wood 4 oz. In practice, however, less fluid than this would be required.

Detailed instructions, based on the author's experience, are given for the preservation and restoration of worm-infested furniture and for preserving from attack modern or antique furniture which has not hitherto been affected. The complete method of treatment recommended comprises five processes, of which, however, only the first need be applied in many cases. The processes consist of (A) destruction of the worm by means of a thorough application of turpentine, either alone or with the addition of 5–10 per cent. of paraffin oil; (B) filling up the worm-holes and other defects on the unpolished surface by means of suitably coloured preparation of hard paraffin wax or beeswax, or a combination of these and similar bodies with turpentine; (C) filling up the worm-holes on the polished or exposed surfaces by means of suitable coloured wax preparations; (D) restoration of damaged or missing parts by means of coloured wax preparations, and (E) the insertion of liquid fillers to very fragile pieces.

In an appendix suggestions are made regarding the application of the method of treatment to beams, rafters and other structural timbers.

The book is concerned almost solely with the author's methods of dealing with the furniture beetle, but there is a brief summary of other processes, compiled largely from Dr. Gahan's useful account of the pest issued by the British Museum (Natural History).

Plant Autographs and their Revelations. By Sir Jagadis Chunder Bose, M.A., D.Sc., LL.D., F.R.S., C.S.I., C.I.E. Pp. xiv + 231, 8½ × 5½. (London: Longmans, Green & Co., Ltd., 1927.) Price *7s. 6d.*

The investigations of Sir Jagadis Bose into certain aspects of the physiology of plants have aroused much interest. While it would not be appropriate here to discuss either the phenomena which have formed the subjects of the researches, or the conclusions reached by the investigator, satisfaction may be expressed at the appearance of a book which gives in a concise and simple form an account of the work carried out in the Bose Institute at Calcutta. An inspection of the list of volumes published by the author indicates the extensive character of this work, and the point is emphasised by the fact that in the book now under notice twenty-seven chapters

(most of them self-contained) are occupied in giving an account of the more important researches. There is no lack of the somewhat fanciful language which is familiar to students of these enquiries, but the book will be most useful to those desiring to acquaint themselves with Sir Jagadis Bose's work and methods.

The Scientific Feeding of Animals. By Professor O. Kellner. Authorised Translation by William Goodwin, M.Sc., Ph.D. Second Edition revised 1926. Pp. xiii + 328, $7\frac{1}{2} \times 5$. (London: Duckworth & Co.) Price 8*s.* 6*d.*

The first English edition of Kellner's *Grundzüge der Fütterungslehre* appeared in 1909, and the present revised or second edition preserves the main features and arrangement of that edition. Both editions have closely followed the original, as it was held that any considerable alteration or attempt to rearrange the book so that it should be more in accordance with English practice would destroy the character and impair the clearness and precision of Kellner's admirable work. The present edition includes the additional matter contained in the latest—seventh—German edition, which has been revised and brought up to date by Professor Fingerling, who succeeded Professor Kellner at Möckern. The principal additions are a page on vitamins and the amplification of the section on silage. Otherwise the book is unaltered.

Mechanical Refrigeration. By Hal Williams, M.I.Mech.E., M.I.E.E., M.I.Struct.E. Pp. xii + 513, $8\frac{1}{2} \times 5\frac{1}{2}$. Third edition. (London: Sir Isaac Pitman & Sons, Ltd., 1927.) Price 20*s.*

Any discussion of the practice of refrigeration necessarily stands upon a theoretical basis of mathematical physics, and the statement, made in the preface to the previous edition of this book, that it is written from the point of view of the owner, the user, and the student, rather than from the purely technical standpoint, must not be taken as implying that it offers an understanding of the subject without a grasp of scientific principles.

The first two chapters deal with the thermal properties of fluids and with the principles of thermodynamics, and form a useful " refresher " for the scientifically trained reader whose physics have become rusty. An extensive consideration of the different processes and plant employed in refrigeration is introduced by a historical survey of types of machines used in the past and an account of the properties of ammonia and carbonic anhydride. Chapters

on insulation and on brine come next, after which the manufacture of ice and the technology and applications of cold storage are dealt with in considerable detail. A variety of other applications of refrigeration in the arts and industries is discussed, and a final chapter deals with the design of abattoirs, freezing and meat packing works.

British Chemicals, their Manufacturers and Uses. 1927 Edition. Pp. 286, 10 × 7½. (London: Ernest Benn, Ltd., 1927.) Price 10*s.* 6*d.*

This publication, the greater part of which is printed in English, French, Spanish, Italian, Portuguese and German, contains a directory of firms who are members of the Association of British Chemical Manufacturers, a classified list of the products made by these firms with brief notes as to their uses, a list of proprietary products with their manufacturers, and key indexes in the five foreign languages mentioned above.

The work should be of value especially in extending foreign trade in British chemical products.

Business Geography. By Ellsworth Huntington and Frank E. Williams, with the co-operation of Robert M. Brown and Lenox E. Chase. Second Edition, Rewritten. Pp. xvi + 616, 9 × 6. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1926.) Price 17*s.* 6*d.*

A notice of the first edition of this book, issued in 1922, appeared at the time in this Bulletin (1922, **20**, 562), and not much therefore need be said here regarding the general plan and scope of the work. For the purpose of the present edition the book has been largely rewritten and generally improved as well as considerably enlarged, and it well fulfils its main purpose as a textbook for college students. The contents are arranged in a practical and instructive way and the authors' attractive style renders the volume very suitable for general reading.

The Geology of South Africa. By Alex. L. Du Toit, D.Sc., F.G.S. Pp. xi + 463, 9 × 6. (Edinburgh and London: Oliver & Boyd, 1926.) Price 28*s.*

In the first chapter of this book the author gives about a dozen pages to a brief account of geological principles by way of introduction. The second chapter deals equally briefly with the physical geography and geological structure of South Africa. Following this are chapters

(3 to 17) giving an account of the various stratigraphical systems of South Africa, including separate chapters devoted to igneous intrusives such as the old granites, the Bushveld Complex, the Karroo dolerites, and the volcanic pipes younger than the Stormberg volcanoes. There are chapters on primitive man, the soils of South Africa and the economic geology of the region. The final chapter deals with the geological history of South Africa and there is an appendix giving rock analyses, also a long index and a coloured geological map.

The geology of South Africa has many distinctive features. The subject is one on which a voluminous literature has accumulated in recent years, and the time was ripe for the issue of a book setting forth clearly and concisely the basic facts and indicating the progress that has been made. In a book of 463 pages on this big subject, everything could not be included ; but it might have been well to append a select bibliography. Such a bibliography would have been more useful than is the appendix on rock analyses, especially considering the numerous useful papers on South African geology to which the author has had to avoid reference for want of space. In this respect the index is not an adequate guide to the text, and the absence of an item in the index does not necessarily mean that the author has made no mention of the matter in the text, but rather that the index is incomplete.

However, it would be ungrateful not to speak of this work as a whole in terms of strong appreciation. No author could be better qualified than Du Toit for the task of writing such a book, and he has carried it out very well. Much praise is due also to the publishers for their part in producing in such good style a book which is likely to be a standard work of much value for many years to come.

THE GEOLOGY AND METAL DEPOSITS OF CHILE. By James Macfarlane Little, E.M. Pp. ix + 188, 9½ × 6. (New York : The Bramwell Company, 1926.) Price $5.00.

This book is based mainly on observations made by the author when examining some 250 mines, nearly all of copper and situated almost entirely in the provinces of Atacama and Coquimbo, Chile, during a period of two and a half years.

The first half of the book deals with the physiography and general geology of Chile, more especially with that of the area mentioned. A table of rock formations shows that manganese deposits occur in Mesozoic sandstone

formations, whilst all other metalliferous deposits—grouped as epigenetic, and mainly of copper, silver, iron and gold—occur in or near tertiary granitic intrusions.

The latter half of the book commences with a table of 242 mines, examined or visited by the author, and their location, with nature of deposit, country rock, primary sulphides and temperature of formation, whether high or low. Brief descriptions of the mines follow, illustrated by sections in some cases, but the information given is very scanty. For example in the case of the Tofo iron mine in La Serena department it might have been mentioned that there were over 100 million tons of 67½ per cent. ore, and with the Potrerillos copper mine in the Chañaral department, that there were over 30 million tons of 1½ per cent. ore. In this connection it should be mentioned that although the preface of the book is dated April 1918, it was not published until over eight years afterwards, and many changes may have occurred in that period.

The book includes some useful geological sections and maps, but it contains no index, a defect which is, however, to some extent compensated for by the list of contents.

A Geographical Study of Coal and Iron in China. By Wilfred Smith, M.A. Pp. 83, 8½ × 5½. (Liverpool: University Press of Liverpool, Ltd.; London: Hodder & Stoughton, Ltd., 1926.) Price 5*s*.

The subject of China's mineral resources is one concerning which comparatively little has been known until recent years; but, as a result of the researches of various mining engineers and geologists and of the establishment of the Geological Survey of China, a considerable amount of information has now been published. In this handbook the author has summarised the information available in a very convenient form. It is divided into four chapters, which deal respectively with: the general geological structure of China as regards coal and iron ore deposits; regional resources of these minerals, including a tabular summary of the anthracitic and bituminous coal reserves of the country, with estimates of the different authorities; factors affecting the future of the coal and iron industries of China, and the relations between China's industries and the working of the deposits. The text is illustrated by a number of sketch maps, besides which there are two larger maps showing the distribution of the coalfields of North and South China. A bibliography of

all the important publications on Chinese coal and iron concludes the volume.

LABORATORY METHODS OF DETERMINING THE INFLAMMABILITY OF COAL DUSTS. By A. L. Godbert. Safety in Mines Research Board Paper No. 31, Mines Department. Pp. 68, 6 × 9½. (London : H.M. Stationery Office, 1926.) Price 1*s*. 6*d*.

Coal dust is inflammable, but its inflammability can be reduced by intermixture with incombustible dust. Various coal dusts, however, have different degrees of inflammability, and the quantity of incombustible dust to be added to a particular coal dust in order to render the mixture incapable of propagating flame consequently varies. The inflammability of coal dust is dependent upon a number of factors, and several laboratory methods have been proposed for determining relative inflammabilities with sufficient accuracy to render extensive large-scale tests unnecessary.

This paper gives a historical survey of the subject. It deals with the influence of various factors on the inflammability of dust clouds and the relative inflammabilities of coal dusts. The lines of further researches now proceeding in the Board's laboratories at Sheffield are indicated, and the paper should be regarded as a preliminary report on the results of those researches.

THE PRINCIPLES OF PETROLOGY. AN INTRODUCTION TO THE SCIENCE OF ROCKS. By G. W. Tyrrell, A.R.C.Sc., F.G.S., F.R.S.E., Ph.D. Pp. xii + 349, 7½ × 5. (London : Methuen & Co., Ltd., 1926.) Price 10*s*.

This excellent book is one of Methuen's Geological Series, which is being issued under the general editorship of Professor J. W. Gregory. Its author, who is Lecturer in Geology at the University of Glasgow, is a well-known petrologist and is highly qualified in every way for the task of writing such a book, which task he has carried out in very good style.

In his introduction, the author recognises a distinction between petrography and petrology. Petrography he defines as a descriptive account of rocks from the chemical, mineralogical and textural points of view ; petrology is a broader term, including both petrography and petrogenesis, the study of origins. He says further that, broadly speaking, petrology is the application of the principles of physical chemistry to the study of naturally-occurring earth materials, and it may therefore be regarded as the natural-history branch of physical chemistry.

It is with this broader petrological aspect of the subject that the author deals.

In a brief introductory chapter (pp. 1–12), an account is given of the structure and composition of the earth as a whole, rocks and their composition, rock-forming minerals and the classification of rocks. Rocks are divided into three classes according to the usual custom, viz. igneous, secondary (sedimentary) and metamorphic, the remainder of the book being devoted to an account of these three classes of rocks as follows: igneous, pp. 13–170; secondary, pp. 171–249; metamorphic, pp. 251–336. The book concludes with a useful index.

The author assumes, somewhat boldly perhaps, that all that is good in the work of the older petrologists has been incorporated in the practice of modern workers, and so in this book he restricts references almost entirely to books and papers of fairly recent dates. The result is a compact, handy and up-to-date textbook, the scope of which is eminently suited to the requirements of students of petrology, who are fortunate in having put before them such a clearly written, concise and interesting account of the main elements of modern petrology.

Treatise on Sedimentation. By William H. Twenhofel and collaborators. Pp. xxv + 661, 9½ × 6. (London: Baillière, Tindall & Cox, 1926.) Price 34*s*.

The study of sediments and its bearing on geology is a subject on which there has been much active work in recent years. This treatise by Twenhofel and his collaborators has been prepared under the auspices of a Committee on Sedimentation, connected with the Division of Geology and Geography of the National Research Council of the National Academy of Sciences, United States.

Chapter 1 (22 pages) deals with the sources and production of sediments, including those of terrigenous, organic, volcanic, magmatic (*sic*) and cosmic origin. The author appears to exercise great care in avoiding the use of the term "weathering" in this chapter, without explaining why. Instead we get such expressions as "rock-breaking" and "rock-rotting," which, even taken together, are at best but a clumsy substitute for the useful term "weathering." Later on in the book the term "weathering" is used rather loosely in connection with a process of chert-formation by solution and replacement.

Chapter 2 (pp. 24–82) gives an account of the transportation, deposition, diagenesis and lithification of sediments, and is followed by two short chapters on modification

produced by climatic and organic agencies. Chapter 5 (pp. 152–431) is an important one, dealing as it does with products of sedimentation. Long as this chapter is, it appears not to mention petroleum, although oil-shale is dealt with. Gypsum, phosphate, manganese, barium and strontium deposits are referred to, but no consideration is given to gold, or to sedimentary deposits containing many other important metals such as copper, lead, zinc and vanadium; and nothing appears to be said about fuller's earth.

Chapter 6 (pp. 432–549) deals with structures, textures and colours of sediments, while Chapter 7 (pp. 552–618) gives an account of "environments or realms of sedimentation." A final chapter (pp. 620–635) on field and laboratory studies of sediments is too brief to be of much use, but the reader is referred to other publications from which fuller details can be obtained.

On the whole this treatise gives one the impression that it lacks balance in its make-up, both as regards text and illustrations. It contains a good deal of ill-digested matter, much of which the reader could well spare, while at the same time it is lacking in material that could with advantage have been included, more especially as regards references to important items of European and other literature that the author has omitted to mention.

However, it is only fair to allow that the subject is a big one and the literature very extensive. Readers interested in the petrology of sediments will be grateful to the author and his collaborators for the efforts they have made to deal so fully with a branch of petrology which, until recent years, has suffered much neglect.

CEMENT, CONCRETE AND BRICKS. By A. B. Searle. Pp. x + 441, 9 × 6. (London: Constable & Co., Ltd., 1926.) Price 24*s*.

This book, which is a second edition of one published in 1913, deals with the three types of constructional material enumerated in the title.

The first portion of the book deals briefly with the raw materials of, and methods employed in, cement manufacture, the term cement being used to include Portland, natural-slag and aluminous cements, hydraulic limes and pozzuolanas. Then follows a discussion of the theoretical considerations involved in the manufacture and setting of cement, based largely on the work of Messrs. W. & D. Asch and of J. W. Cobb. Chapter V deals with the testing of cement, mainly according to the requirements of the British Standard Specification.

The second portion of the book deals with the raw materials used in and the preparation of concrete and includes a short discussion of methods of water-proofing. A chapter on reinforced concrete is included, together with others on the special properties of concrete (fire resistance, permeability, etc.), and methods of testing.

The third portion of the book, comprising 119 pages, deals with the raw materials of bricks, methods of brick-making and the properties of bricks. This portion of the book might perhaps have been omitted, especially as the author has already dealt with the subject more extensively in another work which readers of the present volume are frequently advised to consult; e.g., Chapter XII on the methods of brick-making, contains five references to this previously published treatise.

The need for more careful revision and proof-reading of the book is shown by the number of carelessly worded or inaccurate statements in various parts of the book. For example, on page 5 it is said that "there are many alumino-silicic acids which have so similar a chemical composition that some of them cannot readily be distinguished by analysis. Such compounds are known as isomers. . . . Many clays used in cement manufacture are probably isomeric, this apparent similarity in analysis being merely a coincidence." Again, on page 320 he states that "the plasticity numbers of a certain chemist in London represent china clay as less plastic than ball clay, whereas all potters hold precisely the reverse opinion." There is some needless repetition in this section, as, for example, on pages 313 and 402, in dealing with grey bricks.

The book is marred by a paucity of complete references to other works which have been used in its compilation, in many instances the name only of the worker being given. The oft-repeated exhortation to "consult an expert" also becomes annoying. The price of the book appears somewhat high, but the fact that it has reached a second edition indicates that it has been found of some value to those wishing to obtain a general outline of the materials and processes with which it deals. The book, like others of this series, is well bound and printed.

Successful Asphalt Paving. By P. J. M. Larrañaga, M.Inst.Petr.Techn. Pp. xx + 255, 9¾ × 6. (London: Richard Clay & Sons, Ltd., 1926.) Price 12*s.* 6*d.*

In the sub-title, this book is characterised as a description of up-to-date methods, recipes, and theories, with examples and practical hints, for road authorities,

contractors and advanced students. The author has had considerable experience in asphalt and throughout the book includes, whenever possible, arguments showing the superiority of asphaltic roads as compared with those constructed of other material. His style is chatty and interesting and readily holds the attention of the reader.

After introductory chapters on the nature of bitumen and colloidal substances the author describes the chemical and physical tests which are usually applied to the material, carefully indicating the bearing of the results of such tests on the behaviour of the material in use. Throughout the book the necessity is emphasised of adequate technical supervision in all stages of asphaltic road constructions, and in this connection the chapter on "preliminary technical preparations" is of interest. Sections are devoted to the manufacture of hot mixed asphalt paving, rock asphalt paving and bituminous emulsions. Attention is also given to the administrative side of the work such as plant management, costs, estimates and tenders.

The book is intended for those who already have some knowledge of the subject, but it contains also much that will be of service to all interested in the subject of asphalt or roads made therefrom. It is well illustrated with numerous photographs of machinery and of roads constructed with the several types of asphaltic material.

BOOKS RECEIVED FOR NOTICE

The Trade, Industries, Products, etc., of South Africa and Adjacent Territories. A Business and General Handbook. Compiled from Official Sources by C. W. Francis Harrison, F.S.S., F.R.G.S. Pp. 550, $9\frac{1}{2} \times 7\frac{1}{2}$. (Pietermaritzburg: The Natal Witness, Ltd., 1926.) Price *21s.*

Careers for Rhodesian Boys and Girls. By B. B. Hill and T. G. Standing. Pp. 88, $8\frac{1}{2} \times 5\frac{1}{2}$. (Manchester: Charles H. Barber.) Price *2s. 6d.*

A Trip to China. By William H. Ukers, M.A. Pp. 43, 10×7. (New York: The Tea and Coffee Trade Journal Co., 1926.) Price 25 cents.

Directory of Paper Makers of the United Kingdom for 1927. Pp. 268, $10\frac{1}{2} \times 7\frac{1}{2}$. (London: Marchant Singer & Co., 1927.) Price *5s.*

ARTIFICIAL SILK. ITS MANUFACTURE AND USES. By Thomas Woodhouse, F.T.I. Pp. xiii + 137, 8½ × 5½. (London: Sir Isaac Pitman & Sons, Ltd., 1927.) Price 5*s*.

MINERAL RESOURCES OF SOUTHERN AFRICA. By S. J. Lett, M.I.M.M., F.R.G.S. Pp. 86, 8½ × 5½. (South Africa: Central News Agency, Ltd., 1926.) Price 6*s*.

BAUXITE. By Cyril S. Fox, D.Sc., M.I.M.E., F.G.S. Pp. xii + 312, 10 × 6½. (London: Crosby Lockwood & Son, 1927.) Price 30*s*.

THE CHRISTIAN MISSION IN AFRICA. A Study Based on the Proceedings of the International Conference at Le Zoute, Belgium, September 14 to 21, 1926. By Edwin W. Smith. Pp. viii + 192, 10 × 6¾. (London: The International Missionary Council, 1926.) Price 3*s*. 6*d*.

REPORTS OF RECENT INVESTIGATIONS AT THE IMPERIAL INSTITUTE

Selected from the reports made to the Dominion, Colonial and Indian Governments

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THE IMPROVEMENT OF IRAQ WOOL

THE Agricultural Department in Iraq are carrying out an investigation into the possibility of producing from Iraq sheep a type bearing better fleeces than those yielded by the present flocks. As most of the so-called breeds of the country are far from homogeneous an endeavour is being made to fix a type, and a flock of a breed known as "Shefali" has been purchased. In connection with this investigation five fleeces, representing the heaviest and best-looking from these sheep, were forwarded to the Imperial Institute for examination in October, 1926.

The fleeces were brought to the notice of the Imperial Institute Advisory Committee on Animal Fibres at their meeting on December 17, 1926, and two of the members, Mr. F. A. Aykroyd and Mr. Harry Dawson, kindly undertook to examine the specimens and to furnish a report.

The fleeces were examined in detail by Mr. Aykroyd, and mounted specimens showing various qualities of wool which exist in one fleece were prepared for the information of the Agricultural Department. These specimens demonstrated that the strong hairs varied in quality from the top of the hair to the bottom, and again in the middle. One specimen was beautifully even, fine wool which was undoubtedly of good value.

Mr. Aykroyd recommended that the breeders of these wools should endeavour to obtain uniformity whether the hairs are uniformly fine or uniformly coarse, as the presence of two or three qualities of so varied a nature in the same staple renders the wool useless except for the carpet trade,

and such wool realises low prices. It was also pointed out that it would be desirable to cross the native ewes with the purest bred rams available, but before advising what class of rams to use it would be necessary to have some knowledge of the climatic conditions. Two or three years of judicious breeding should eliminate the strong hairs and produce uniformity of staple.

In view of the above statement an enquiry was addressed to the Inspector-General of Agriculture asking for particulars of the climatic conditions of the region in which the sheep are bred, and in reply the memorandum printed below was received. The matter was further discussed at a subsequent meeting of the Committee on Animal Fibres when Professor Aldred F. Barker, M.Sc., of the Department of Textile Industries, Leeds University, kindly undertook to prepare a memorandum on the subject (see p. 214).

The Agricultural Department in Iraq were informed that the Committee would be glad to receive observations on any questions dealt with in the report or in the accompanying memoranda and to render any further service that might be possible in connection with the production of wool in Iraq.

Memorandum on the Climate and Soils of Iraq, by the Inspector-General of Agriculture, Baghdad

In forwarding this memorandum the Inspector-General of Agriculture remarked that, in the hilly and mountainous tracts north of Mosul, winter temperatures are frequently very low with snow or frost persisting for days at a time. The sheep-breeding problem, therefore, has two sides; to produce one animal to thrive in the plains and another for the hillier and (in winter particularly) colder regions of the North.

Climate

Weather conditions are of the arid continental type, with the exception of a mountainous tract in the extreme North. Rainfall, confined to the months October–April, and more usually November–March, varies a good deal annually and ranges from 4 to 10 ins. in Southern and middle Iraq, where irrigation practically determines cultivation,

to 16 or 20 ins. in the sub-montane rolling plains around Mosul, Arbil and Kirkuk in the North, where dry farming for winter cereal crops is practised.

Summer temperatures are extremely high; from June to September daily maxima nearly always exceed 100° F. and are usually 110–115° with periods around 120° or even over 125° during July and part of August. Atmospheric humidity is generally very low and strong northerly winds increase the transpiration in vegetation considerably. The seasons when plants grow most rapidly are from mid-September to end of November and from mid-February to end of May with daily maxima of 75–90° F. December, January and part of February are frequently cold with occasional night frosts, sometimes severe, and while growth of such plants as lucerne rarely ceases it proceeds slowly. European vegetables such as lettuce, cabbage, beetroot, peas and beans, flourish in the cool season, while cotton, sesame, *Hibiscus cannabinus* and cucurbits grow throughout the hot weather.

Soils

Middle and lower Iraq is a great alluvial plain formed from the detritus borne and deposited by the Tigris and Euphrates. The soils are remarkably similar in widely separated areas and may be generally described as rather strong loams, prone to bake hard on drying, containing about 20 per cent. of calcium carbonate, well supplied with potash, generally adequately supplied with phosphates, but often deficient in nitrogen in any form.

Under irrigation they are apt to become salty, but so far no "black alkali" (sodium carbonate) has been observed. Natural drainage scarcely exists as the two rivers have raised their own level to a height greater than that of the rest of the plain.

The northern undulating sub-montane areas seem also alluvial in origin as a rule, but are presumably of much greater geological age; they tend to be more friable in nature and, being naturally drained, seldom suffer from salting even under irrigation. Even here there is practically no natural timber or even scrub growth; water run-off is very considerable where the land is not ploughed.

Memorandum on Sheep-Breeding in Iraq, by Aldred F. Barker, M.Sc., Professor of Textile Industries, The University, Leeds.

The discussion at the meeting of the Advisory Committee on Animal Fibres held on March 18, 1927, led to the suggestion that certain experiences in sheep-breeding and wool-growing in Peru might be usefully considered by those charged with the development of Iraq as a sheep and wool country.

1. *Environment.*—The greatest sheep track of flat land in Peru is to the south and is at an elevation of 12,000 to 13,000 feet up the Andes. Thus, although near the equator, the country is "winter parched" rather than "summer parched." The rainfall usually results in a good spring and summer growth of grass which, owing to the dryness of the atmosphere, dries on the land and forms the winter pasturage for the sheep. At present, the sheep are driven from the farm each morning to the grazing tracts of land and are brought back at night. This leads to an indiscriminate utilisation of the pasturage which, in a dry year, may lead to lack of food and a break in the wool staple. To overcome this, the fencing-in of the pasturage and the control of feeding is being carried out, with the result that the wool staple is now perfect and the land carries its maximum of sheep. The land carries about a sheep to the acre and, consequently, may be fenced-in more economically than the lands of Patagonia carrying one sheep to from four to seven acres: these latter lands are now practically all fenced-in. Iraq should carefully consider the fencing-in and the best utilisation of its low-lying—possibly irrigated—lands, for this means it may not only carry more sheep, but also provide a better wool staple. The mountainous lands will probably be best left in their present open state.

2. *Native Sheep.*—The Merino sheep, which may now be considered native to Peru, is of the original Spanish merino type, unfortunately contaminated with a rougher type of sheep. The climatic conditions seem to have kept it small, and unfortunately it is very "kempy." It is found, however, that certain of the lambs born with the outer hair or kemp coat cast it early, retaining only their

pure wool coat. On the supposition that the hair coat is a useful protection at birth, but a serious contamination to the wool later, the type of lamb referred to is being selected as the native stock upon which to develop a better type by crossing purposes.

In Iraq the best type of Native sheep should be carefully selected in like manner as a basis for an improved breed. It may be that two types—one for the mountains and one for the plains—should be selected; producing a strong and a fine wool respectively, but there is probably no reason why both districts should not produce pure wools. There is, however, a good demand for strong wools for the carpet trade which should be carefully considered.

3. *Breeds for Crossing.*—On the heights of the Andes the sea-level Romney Marsh sheep has not proved a success, while the hill-country sheep—the British "Downs"—have proved themselves very robust under the prevailing trying conditions. Merinos also do well—but the grass-fed natural merino better than the larger-bodied artificially fed merino. In Iraq the fining of the wool should certainly be tried with the merino (or possibly with fine English Downs), but care should be taken in the selection of the type, a northern Australian, rather than a Victorian or Tasmanian type, or even a South African type, being the preferable. The Romney Marsh (well-bred) should prove the best sheep for low-lying irrigated lands.

If it is decided to develop a stronger type of sheep and wool on the mountains, the desired type of sheep and wool may be attempted (*a*) by selecting from native stock towards the strong side; or (*b*) by introducing such a type of sheep as the Scotch Blackface. By one or other means a useful type of strong carpet wool might be developed.

4. *Method of Crossing.*—The normal farmer's method of crossing the native ewes with an improved ram, then crossing the half-breds with the improved ram, and so on, may be followed; or the Mendelian method of crossing the half-breds with themselves to obtain the variations from which to select. In Peru the first method is being followed, but a double-cross upon the native ewe is being carried out—the first cross with, say, a Southdown or

Dorset Horn sheep to improve the mutton and body size, and the second and subsequent crosses with the Rambouillet Merino to improve the quality of the wool.

In Iraq it might be well to employ the Mendelian method to obtain a reshuffling of characters, then to observe which new type fits the environment the best, and finally to work upon this for the new breed.

In concluding this memorandum, Professor Barker pointed out that he felt some diffidence in giving the report as he realised so inadequately the type or types of country and knew so little of the types of sheep upon which it might be possible or advisable to work.

Professor Barker subsequently furnished the following definite recommendations regarding sheep-breeding in Iraq.

1. Iraq should carefully consider the control of its pasturage from the point of view of (*a*) the number of sheep it may carry; (*b*) the soundness of staple it may produce.

2. Before introducing so-called improved breeds, Iraq should consider what can be made out of its native breed, which is probably specially adapted to the climatic conditions.

It is probable that Iraq may produce a finer wool than it is producing at present, but it should by no means eliminate the strong wool type of sheep without being sure that it is going to do better with the fine wool sheep.

3. Any improved breeds that may be introduced should be carefully selected with the Iraq climatic conditions clearly in mind.

A mountain sheep does not do well on irrigated lands, nor does such a sheep as the Romney, which is suited for low-lying irrigated lands, do well on the mountains: the race must be adapted to the environment.

4. If it is felt that an altogether different sheep is required for Iraq then the Mendelian method of crossing the half-breeds should be followed.

If, however, the desired type of breed or breeds is clearly in evidence, then there is no reason why this should not be further developed on the lines being followed in Peru.

WOOL FROM PALESTINE

Two samples of wool were received for examination at the Imperial Institute in December, 1926, from the Secretary of the Economic Board for Palestine. It was desired to ascertain the value of such wool in the London market and to obtain information regarding methods of washing the wool, if necessary, and of packing it for export.

The samples consisted of three packets each containing about 3 oz. of untreated clippings which were rather sandy but otherwise fairly clean. One of the envelopes, labelled No. 1, was stated to contain wool from the living sheep whilst the two packets labelled No. 2 contained wool from the dead sheep.

The samples were brought to the notice of the Imperial Institute Advisory Committee on Animal Fibres for their opinion as to the quality and value of the wools. A careful examination of the samples was made and a set of mounted specimens, showing the composition of each sample, was prepared for submission to the Palestine authorities. These specimens demonstrated that the wools were of very mixed character and that there was an enormous difference between the fine and the coarse hairs present.

With reference to the value of the wools on the British market, the Committee reported that they would be saleable for use in the carpet trade. Wool of the quality of Sample No. 1 should realise approximately 14*d.* per lb. in the London market, whilst Nos. 2A and 2B should realise 13½*d.* and 12*d.* per lb. respectively (March, 1927). The wools could be marketed satisfactorily in their present condition without washing and are in as good a condition as the wools usually imported from Eastern countries, such as India, China and Tibet. The manufacturers usually prefer that wool should be disturbed as little as possible after it has left the sheep's back. Washing the wool in the country of origin usually hardens it and in any case it has to be washed in the factory before the process of combing.

The mode of packing is not of great importance, but in India and Tibet the wool is always packed in iron

hoop pressed bales containing about 300 lb. per bale, whilst those from China contain about 600 lb. per bale.

The Committee is indebted to one of their members, Mr. F. A. Aykroyd, for the detailed examination and valuation of these wools.

VARIABILITY OF CEYLON ESTATE GRADES OF RUBBER

The following is a report of the London Committee of the Ceylon Rubber Research Scheme on the results of investigations carried out at the Imperial Institute.

It was considered in Ceylon that it would be of interest to determine the extent of variability in rubber prepared commercially on different estates, as it was thought that the information obtained would be useful in planning future investigations. A set of estate rubbers, consisting of twelve samples of smoked sheet, seventeen of air-dried crêpe, and ten of machine-dried crêpe (i.e. dried in hot air), was therefore collected from twenty-four estates and forwarded to the London Committee of the Scheme for examination.

The question of the tests to be applied to these samples was considered by the Technical Sub-Committee in London and it was decided to examine the whole series for variability in the following respects, each of which is of importance in considering the suitability of rubber for manufacturing purposes :

(1) Plasticity.

(2) Time of vulcanisation and tensile strength of a rubber-sulphur mixing.

(3) Mechanical properties when vulcanised in a mixing containing zinc oxide and diphenylguanidine, the latter being an accelerator of vulcanisation.

Full details of the tests and of the results obtained are given in the technical appendix, and in the following account it is proposed to summarise these results and to indicate the general conclusions which can be drawn as to (1) the extent of variability in the three respects mentioned above, and (2) the importance of this variability

in manufacturing processes. Attention is also drawn to problems requiring further investigation.

1. *Plasticity*

As a result of enquiries made in America, Dr. de Vries came to the conclusion that manufacturers require a soft plastic rubber, and he regarded this as a fairly clearly defined demand (*Rubber on the Market and in the Factory*, p. 26). A similar demand exists in the United Kingdom, but important English manufacturers have indicated to the Ceylon Rubber Research Scheme that there is also a demand for tough rubbers of low plasticity. It appears, therefore, that the bulk of the rubber from plantations should be as plastic as possible without sacrificing other properties, but that it would be an advantage to put on the market a proportion of tough rubber. The experience of manufacturers indicates that both kinds are available commercially at present. There is, however, nothing to indicate to the manufacturer which kind he is buying, and unless he tests and grades his rubber before using, considerable difficulties arise from time to time in factory operations.

There are now two well-known methods of determining plasticity, viz. the extrusion method and the press method, and each has the approval of some manufacturers. Both methods have been used to determine the plasticities of the samples dealt with in this report. The results given by the two methods are in accord so that a figure for plasticity obtained by one method can be used as a check upon the figure obtained by the other.

It is important to bear in mind that the manufacturer is interested not only in the plasticity of the untreated raw rubber, but also in that of the rubber after each manufacturing operation previous to vulcanisation. Accordingly in these investigations some of the operations occurring in factory practice were carried out on a small scale and the plasticity of the product determined after each process. For this purpose the rubber was mixed with sulphur and the plasticity of the raw, milled and mixed rubber determined separately. The figures given below refer to the rubber-sulphur mixing only, but the

same conclusions are indicated if the other plasticity figures are analysed (see Technical Appendix).

In addition to sulphur, manufacturers mix with rubber many other substances all of which probably have some effect on plasticity. In view, however, of the lack of knowledge concerning some of the simplest factors affecting plasticity it was decided to confine the experiments on these samples to the preparation of a rubber-sulphur mixing.

The following table shows the relative mean value of the plasticity of three forms of estate rubber from Ceylon, together with the minimum and maximum values.

Form of Rubber.	No. of Samples.	Plasticity.		
		Mean.	Maximum.	Minimum.
Smoked sheet .	12	14·8	26·8	8·8
Air-dried crêpe .	17	12·4	18·7	9·0
Machine-dried crêpe	10	15·0	26·4	11·7

The figures represent the volume of the rubber-sulphur mixing forced through an orifice in a given time under constant conditions, so that the higher the figure the more plastic is the rubber.

The differences between the mean figures for these three forms of rubber are of importance in so far as they indicate that smoked sheet and machine-dried crêpe would be preferred by the manufacturer to the air-dried crêpe as regards ease of working. Air-dried crêpe is tougher on the whole than smoked sheet or machine-dried crêpe and should therefore be suitable for purposes for which a tough rubber is required. The differences, however, are not very large and probably not of great importance.

When, however, the differences of plasticity shown by samples of the same group of specimens are considered, it will be seen that considerable variations occur. This is especially so in the case of smoked sheet. The softest sample of the whole series is one of smoked sheet which when mixed with sulphur extruded at the rate of 26·8 ccs. per hour. On the other hand the toughest sample is also one of smoked sheet which extruded at the rate of 8·8 ccs. per hour. The first sample is, therefore, three times as plastic as the second.

Both the air-dried and machine-dried crêpes show a considerable range of variation in plasticity, but not as great as that of the smoked sheet, in each case the toughest sample being about twice as plastic as the softest. In the case of the machine-dried crêpe, however, the majority of the results are extremely close to each other, and, if two exceptional results are excluded, the softest sample is only 28 per cent. more plastic than the toughest sample. The other forms of rubber are by no means as uniform as this (see Frequency Distribution Curves, Fig. 4).

The results given by machine-dried crêpe are all the more interesting because this form of rubber is peculiar to Ceylon. Not only do the results indicate that machine-dried crêpe is more plastic than the other forms but also that less variation in plasticity occurs. If this conclusion is confirmed by further trials there is no doubt that machine-dried crêpe would be in considerable demand, especially in the United States of America, if marketed separately from the air-dried form. It is very desirable that further studies should be made on the uniformity of this form of rubber.

II. Vulcanisation Tests (in a rubber-sulphur mixing)

(a) Variation in time of Vulcanisation.—In manufacturing operations rubber is mixed with sulphur and other substances and is then heated to produce the effect known as vulcanisation. It is important that the period of heating should be correctly adjusted or the vulcanised rubber will have inferior mechanical or ageing qualities.

It is well known that variations occur in the time required to produce a definite vulcanisation effect in different plantation rubbers. These variations are most marked when the rubber is mixed with sulphur only. Tests in a rubber-sulphur mixing are, therefore, the best means of obtaining indications of abnormality in vulcanising properties.

Dr. de Vries concluded from his enquiries amongst American manufacturers that as regards vulcanising properties in a rubber-sulphur mixing an extreme variation from the average of 20 per cent. for crêpe and 25 per cent. for sheet was satisfactory (*Rubber on the Market and in*

the Factory, p. 67). The chief chemist of the Goodyear Tire and Rubber Co., states, however, that such a variation is too great for good manufacturing practice (*Ind. Eng. Chem.*, February 1926, p. 148).

Dr. de Vries also states that for special purposes there is a demand in America for a rubber which does not show a greater deviation from the average than 10 per cent. in time of vulcanisation in a rubber-sulphur mixing. Information received by the Ceylon Rubber Research Scheme from English manufacturers also indicates that the deviation from the average should not be greater than 10 per cent., and this has been adopted as the standard of uniformity in the present report.

In view of the limited number of samples of the three forms of rubber examined, it is not possible to draw definite conclusions as to the relative range of variation in the three groups, but it is interesting to note that less variation occurs in the case of the machine-dried crêpes than in the case of the other two forms of rubber.

It will be seen from the results given in the technical appendix that the average time of vulcanisation of the twelve samples of smoked sheet is 118 minutes and that, excluding one exceptional sample, the range of variation is from 8 per cent. below to 16 per cent. above the average.

In the case of the seventeen air-dried crêpes the average time of vulcanisation is 128 minutes, and the range of variation is from 13 per cent. below to 17 per cent. above the average.

The average time of vulcanisation of the ten machine-dried crêpes is 125 minutes, and the range of variation is from 6 per cent. below to 11 per cent. above the average.

The range of variation displayed by the smoked sheet and air-dried crêpe is somewhat greater than the maximum of 10 per cent. which some manufacturers consider desirable. On the other hand the machine-dried crêpe would be regarded as satisfactory in this respect.

It is of interest to compare the variability in time of vulcanisation of rubber from Ceylon with that of rubber from Java. Dr. de Vries has published a series of curves showing the variation in time of vulcanisation of rubber from Java (*India Rubber Journal*, 1927, **73**, 313). A

frequency distribution curve has also been drawn for the time of vulcanisation of these thirty-nine samples from Ceylon, and it will be seen that the curve (see Fig. 1) is almost identical with that for crêpe and sheet from Java.

(*b*) *Variation in tensile strength.*—The range of variation in the tensile strength of first-grade rubber is about 10 per cent. above and below the average when vulcanised under the best conditions in a rubber-sulphur mixing and tested soon after vulcanisation. Lower grades of

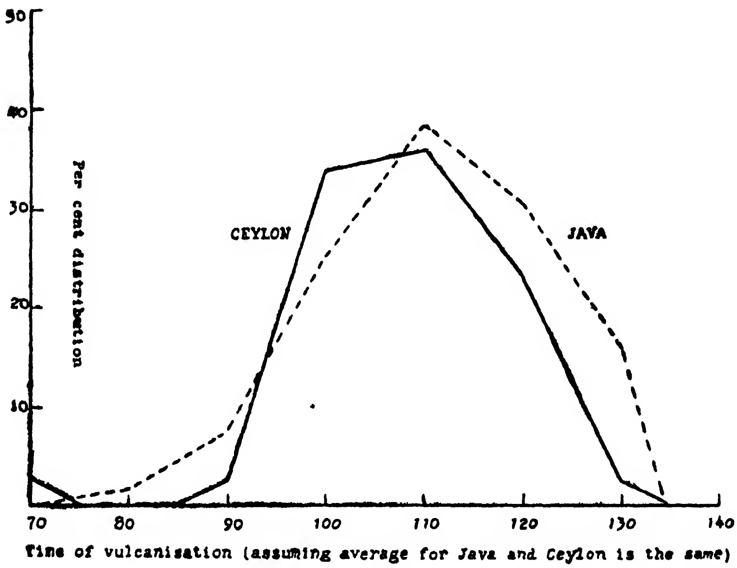

FIG 1 —Frequency distribution curves showing comparison of variability in time of vulcanisation of rubber from Ceylon with that from Java.

rubber, however, are usually much inferior in tensile strength, and may give values as low as half that of first-grade samples. It will be seen, therefore, that tensile strength determinations are of value in distinguishing between samples which are of good quality and those which are definitely of poor quality. It is more difficult, however, to estimate the importance of the 20 per cent. variation which occurs in first-grade rubbers. Although very few manufactured articles are stressed to their breaking point, it seems clear that a tensile strength higher than the average allows a bigger margin of safety and should therefore be an advantage. On the other hand rubber is usually mixed

with other substances in addition to sulphur and most of them have a considerable effect on tensile strength. Investigations of the Ceylon Rubber Research Scheme show that sometimes a sample which is somewhat weaker than the average in a rubber-sulphur mixing is stronger than the average when tested in another mixing; and that a sample which has an average tensile strength soon after vulcanisation may have a comparatively good or a very poor tensile strength after ageing for some time. It would appear that the variation of 20 per cent. in tensile strength of first-grade rubbers is not of great importance.

It is interesting to find that Dr. Twiss of the Dunlop Rubber Co., and a member of the London Committee of the Scheme, states that in the case of articles made of rubber and sulphur only, such as golf ball tape and elastic thread, tensile strength is definitely of importance (*J. Soc. Chem. Ind.*, 1923, **42**, 505T). The tensile strength of a rubber-sulphur mixing depends upon the degree of vulcanisation; the more the rubber is vulcanised, up to a certain point, the stronger it becomes. The estate samples under investigation were vulcanised for the same time, and consequently not to the same degree because of the variation in rate of vulcanisation. They therefore show a much wider range of tensile strengths than the usual 20 per cent. It is possible, however, to estimate the variation in tensile strength allowing for the degree of vulcanisation from Fig. 2 where the percentage of the rubber under a given load (which is often used to measure the degree of vulcanisation) has been plotted against tensile strength. It will be seen that except for two samples the points fall somewhere near a curve, which may be regarded as representing the relation between degree of vulcanisation and tensile strength. These results indicate therefore that all except two of these rubbers from Ceylon are satisfactory as regards tensile strength at normal degrees of vulcanisation, and in so far as tensile strength is of importance in connection with the manufacture of tape and thread, they might be used successfully for this purpose.

The two samples which give points lying some distance below the curve are both from the same estate. They

are definitely weak at this degree of vulcanisation. When vulcanised to give their maximum tensile strength they are still somewhat weaker than the average sample vulcanised to the same degree. Their tensile strengths, however, come within the 20 per cent. range of variation

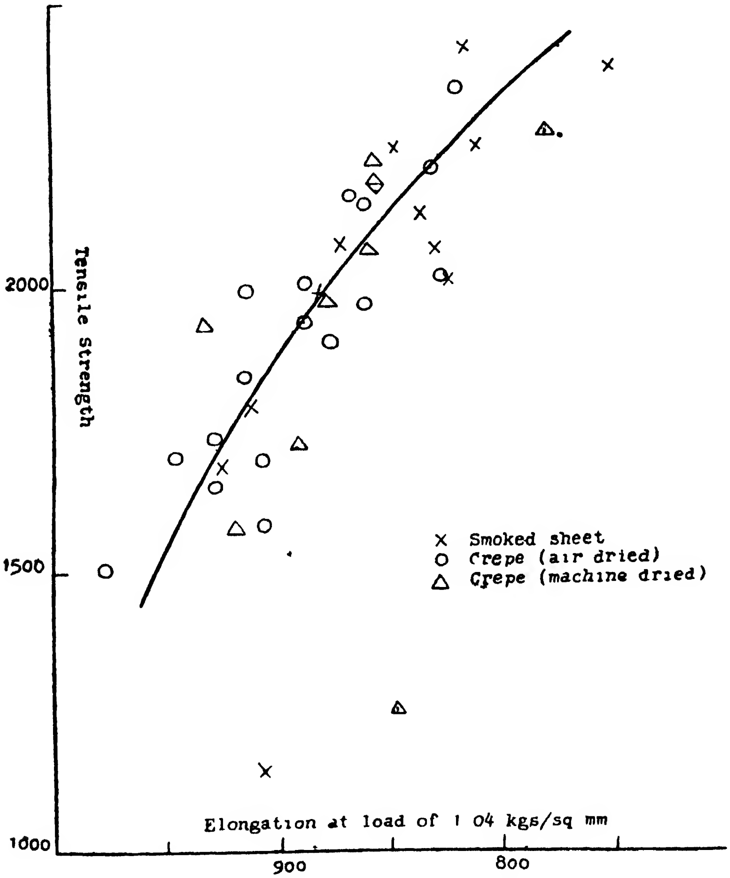

FIG 2.—Curve showing relation between tensile strength and elongation at load of 1 04 kg./sq. mm.

which, it has been explained, occurs in first-grade rubber vulcanised under the best conditions. That they are not sufficiently weak to indicate inferior quality is also shown by the fact that they have excellent tensile strengths when tested in the accelerator-zinc-oxide mixing (see Table C).

It may be concluded that so far as tensile strength soon after vulcanisation is concerned, all these samples of

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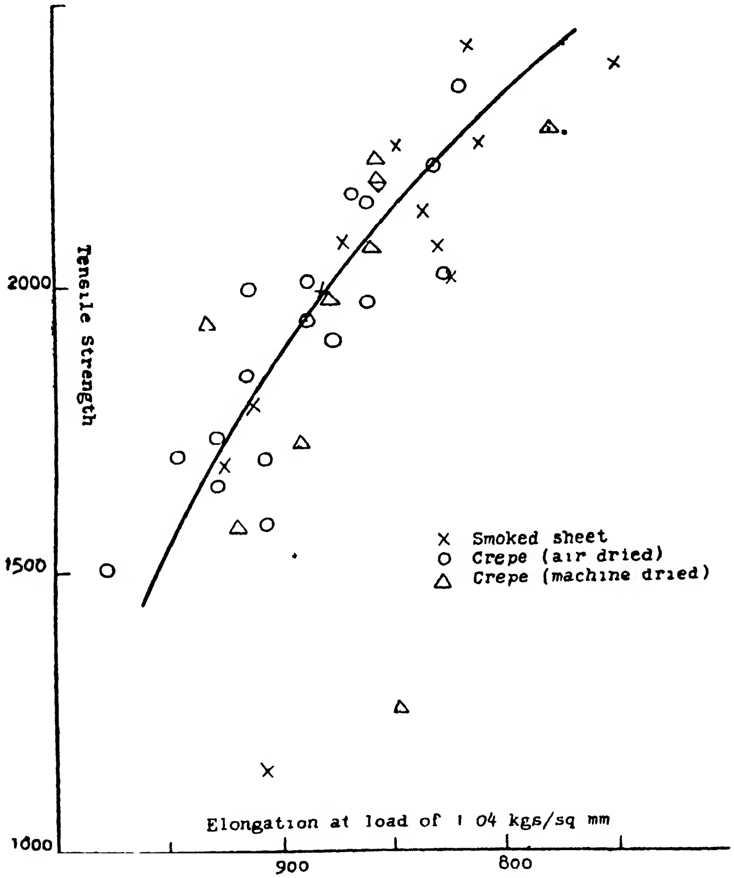

FIG 2.—Curve showing relation between tensile strength and elongation at load of 1 04 kg./sq. mm

which, it has been explained, occurs in first-grade rubber vulcanised under the best conditions. That they are not sufficiently weak to indicate inferior quality is also shown by the fact that they have excellent tensile strengths when tested in the accelerator-zinc-oxide mixing (see Table C).

It may be concluded that so far as tensile strength soon after vulcanisation is concerned, all these samples of

estate rubber from Ceylon are of satisfactory quality for most purposes, but that two of them are less suitable than the others for the manufacture of golf-ball tape and elastic thread.

III. Vulcanisation Tests (in a zinc-oxide-accelerator mixing)

The investigations of the properties of rubber in a rubber-sulphur mixing have undoubtedly yielded very important and practical results; nevertheless it is seldom possible to draw positive conclusions as to the quality of plantation rubber merely from vulcanisation tests in a rubber-sulphur mixing because some of the compounding ingredients now used by manufacturers exert a profound effect on the ultimate results of vulcanisation.

For some time now it has been the general practice of the Ceylon Rubber Research Scheme to test samples not only in a rubber-sulphur mixing, but also in one more allied to those employed more frequently in manufacturing practice. A considerable amount of data on the relation between the results given by the two types of mixing has been accumulated and it is proposed to publish a separate paper dealing with this subject. The conclusions drawn by the technical staff of the Ceylon Rubber Research Scheme from the results obtained indicate that when first-grade rubbers are vulcanised for fixed times in some mixings no important variability occurs. Further investigations are required, however, to determine the effect of different proportions of the various ingredients and also of other types of mixings before general conclusions can be formed.

The mixing used in tests on these estate samples (see Appendix) was chosen because it has been found to be particularly susceptible to the influence of some of the non-caoutchouc substances in rubber. It will be seen from the results in Table C that the range of variation in elongation at a definite load is very small, being from 559 per cent. to 609 per cent. The range of variation in tensile strength is from 2,690 lb./sq. in. to 3,300 lb./sq. in., but like that occurring in the rubber-sulphur mixing it is improbable that this is of importance.

IV. Correlation of the results of the different tests

It is possible that the plasticity and the vulcanising and mechanical properties of rubber are affected by the same causes, in which case there should be some correlation between the results of the different tests. Only in the case of time of vulcanisation and plasticity has any correlation been observed however. The relation between

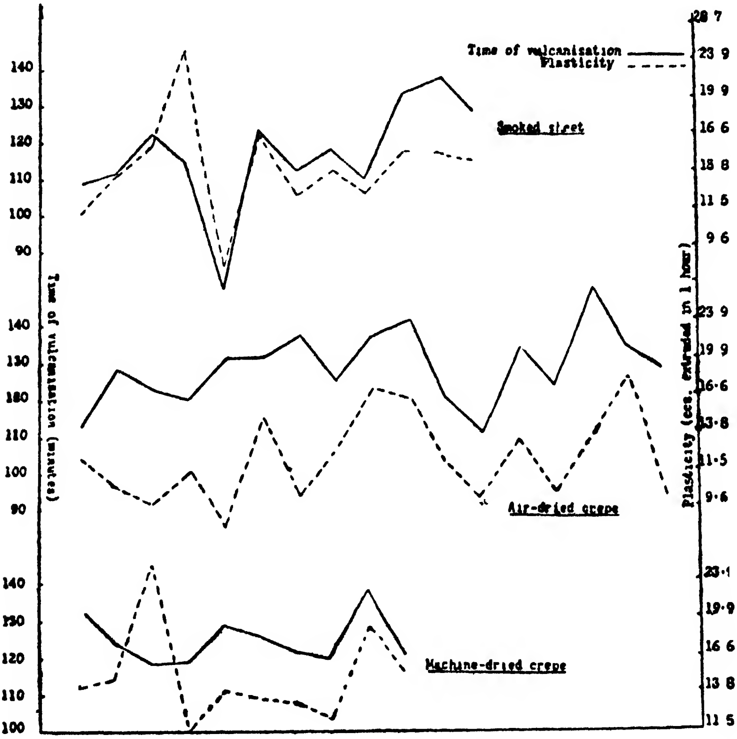

FIG. 3.—Comparison of variation in plasticity with that of vulcanisation in rubber-sulphur mixing.

these two properties is shown clearly in Fig. 3, where the values for the time of vulcanisation of consecutive samples of the three forms of rubber have been plotted together with those of the corresponding plasticities. It will be seen that on the whole a slow rate of vulcanisation is associated with a soft rubber, and a quick rate of vulcanisation with a tough rubber.

It has been stated by the manufacturers represented on the London Committee of the Scheme that this effect

is connected with "maturation" of the rubber which increases the rate of vulcanisation and is stated to harden the rubber. It has long been known that to prepare uniform rubber, special precautions should be taken on estates to standardise that part of the procedure which affects the interval between the coagulation of the latex and the production of the dry rubber. The results obtained in these tests indicate that the importance of this interval is even greater than was previously thought to be the case.

It will be observed that the machine-dried crêpe sample No. 1216 is extremely soft, but does not vulcanise slowly. This sample was dried at a much higher temperature than the others. This appears to have softened the rubber without having had a corresponding effect on time of vulcanisation.

Summary

These investigations show that as regards plasticity the most uniform type of these estate rubbers from Ceylon is machine-dried blanket crêpe, which is a product peculiar to the Colony. Smoked sheet is fairly soft on the whole, but is variable. Air-dried crêpe is frequently tougher than the other forms. It appears, therefore, that the temperature of drying is of importance in connection with the plasticity of the rubber as received by the manufacturer, and that in the case of sheet rubber, drying in smoke serves the useful purpose of making the rubber more easily worked in the factory.

It is presumed from the correlation between the results of plasticity and vulcanising tests that rubber from coagulum which has been allowed to mature is tougher than that from coagulum which has been machined and dried quickly. If this is the case, the extent to which the coagulum has matured appears to be an important cause of such variability as occurs not only in respect of vulcanising properties, but also in respect of plasticising properties. The vulcanising properties of the samples, in a rubber-sulphur mixing, are fairly uniform and similar in this respect to rubber from Java, but only the machine-dried crêpe satisfies the high standard of uniformity desired by some manufacturers.

The results obtained in a mixing containing zinc oxide and an organic accelerator of vulcanisation indicate that variations in vulcanising and mechanical properties in this mixing are of no importance.

A consideration of the results recorded in this report suggests that further investigations would be desirable to determine (1) the cause of the variable plasticity of smoked sheet, (2) the effect of hot air-drying on the plasticity and uniformity of crêpe, (3) the effect of different periods of maturing the coagulum on the plasticity of crêpe and sheet, (4) the degree of uniformity which it is possible to obtain in plasticity and vulcanising properties when rubber is prepared under the most carefully standardised conditions, and (5) the effect of different proportions of various compounding ingredients on uniformity.

TECHNICAL APPENDIX

In this appendix the methods employed in carrying out the tests are described and details of the results are given. Comments are also made on items of technical importance not referred to in the preceding summary.

As in the case of the summary the appendix is divided into three sections dealing respectively with (1) Plasticity, (2) Vulcanisation tests in a rubber-sulphur mixing, (3) Vulcanisation tests in a zinc-oxide-accelerator mixing.

1. Plasticity

(1) *Method of Testing*

The following is an account of the methods employed for the determination of the plasticity of each sample:

(*A*) *Summary of measurements.*—Tests were made on (1) the raw rubber, (2) the masticated rubber and (3) the rubber mixed with sulphur. The determinations made were as follows:

1. *Raw Rubber.*

(*a*) Thickness of a sphere, 0·4 gram in weight after pressing 30 minutes under a weight of 5 kgs. at 100° C.

(*b*) Time of mastication for which the amount of power consumed is 450 watt-hours (plus that consumed by the machinery when running empty for the same period).

2. *Masticated Rubber.*

(*a*) Thickness of a sphere as in 1 (*a*).

(*b*) Time of extrusion of a fixed volume through an orifice ⅛ in. in diameter under load of 165 lb./sq. in. at 90° C.

(*c*) Time of mixing for which the amount of power consumed during the addition of sulphur is 150 watt-hours (plus that consumed by the machinery when running empty for the same period).

3. *Rubber mixed with sulphur.*

(*a*) Thickness of a sphere as in 1 (*a*).

(*b*) Time of extrusion as in 2 (*b*).

(*B*) *Procedure employed.*—The following is an account of the procedure employed in making the above measurements :

Mastication and mixing.

Mixing machine . . .	Rolls 9 in. × 4½ in.
Speed of back roll . . .	27 revs. per minute.
Speed of front roll . . .	21 " " "
Mixing	90 rubber, 10 sulphur.

The mixing mills are first run empty for 30 minutes so that the bearings may get thoroughly lubricated, and then for a further 30 minutes to enable the rate of power consumption to be noted. Through the rolls water heated to 45° C. is passed at the rate of 2 gals. per minute. 550 grams of rubber are then run between the rolls opened to 1·8 mms., a bank being maintained between the nip of the rolls. After 10 minutes the rolls are opened to 2·2 mms., and after 15 minutes to 3·1 mms. From 10 minutes onwards the rubber is cut and folded twice every minute. When the power consumption amounts to 450 watt-hours plus that consumed by the mills running empty for the same period, the period of mastication is noted. 50 grams of rubber are then removed and kept at laboratory

temperature in calender cloth for plasticity tests the next day.

55·5 grams of sulphur are mixed into the remaining rubber until the additional power consumption is 150 watt-hours plus that consumed by the machinery running empty for the same period. The period of mixing is noted and the mixed rubber is then calendered in the usual way. 50 grams are removed the next day and rolled into a cylinder 1 in. in diameter for plasticity tests.

Parallel plate plastimeter.—This plastimeter is similar to that devised by Ira Williams and now frequently employed by rubber investigators. It consists of two parallel plates between which a ball of rubber weighing 0·400 gram is pressed under a load of 5 kgs. at 100° C., this temperature being maintained by keeping the press in an electrically heated oven, fitted with a glass door. The temperature of the press is measured by a thermometer dipping into a well of mercury in the bottom plate.

In the case of raw rubber, strips are warmed in the oven and then rolled up under slight tension and well kneaded so as to make the plies adhere. The edges are cut to make a ball of the required weight and shape.

In the case of masticated and mixed rubber the balls are cut out of the prepared cylinders referred to above.

In carrying out a test a piece of paper is doubled and placed between the plates of the press and its thickness measured. The rubber ball which has been warming for 30 minutes on the bottom plate of the press is then placed in the paper. To allow the oven to regain the correct temperature after opening the door an interval of 3 minutes is allowed to elapse. The weight is then lowered and the thickness of the rubber read after 10, 20 and 30 minutes.

Extruder.—This consists of a cylindrical container of stainless steel 1 in. in diameter and 3 in. in length into which passes a piston with a sliding fit. The bottom of the interior of container is in the shape of an inverted cone, in the centre of which is an orifice ⅛ in. in diameter.

A weight of 130 lb., giving a pressure of 165 lb./sq. in., which is raised or lowered as required by hydraulic pressure, can be made to engage with the piston and so force it into the container. The container is held in position in a water bath at 90° C.

In carrying out an experiment the rubber which was milled the previous day is rolled into a cylinder 1 in. in diameter. This is placed in the container and the piston lowered on to the upper surface of the rubber, which is then given a short preliminary pressing. The rubber is kept in this position for 45 minutes. The weight is then applied. As the rubber extrudes it is carefully pulled clear of the orifice to prevent jamming. Attached to the weight is a scale graduated in $\frac{1}{10}$ in. from which the downward movement of the piston can be read. The time taken for the piston to travel between certain fixed points on the scale is noted.

This is the time required to extrude 12 ccs. of rubber and from this the volume extruded in 1 hour is calculated.

(2) *Results*

The full series of results are given in the following tables:

TABLE A (1)

Plasticity of Smoked Sheet

Sample No	Time of mastication	Time of mixing.	Raw rubber	Masticated rubber		Rubber sulphur mixing 90 10	
			D_{30}	D_{30}	Ev	D_{30}	Ev
	mins	*mins*					
1208	21	10	178	85	6·9	72	11·6
1214	21½	9½	175	85	7·1	71	14·3
1215	23½	9	160	76	12·7	67	19·2
1217	31	13	164	67	14·6	57	26·8
1222	18	8	192	91	4·9	79	8·8
1226	23	10½	167	78	10·1	67	17·3
1227	22½	10	185	81	7·1	68	12·4
1230	22	10	160	78	8·0	64	14·1
1231	24	10½	166	74	8·1	69	12·8
1238	25	11	154	73	9·3	64	15·8
1239	23½	10½	162	77	8·4	64	15·3
1243	24	12	167	80	9·3	67	15·0

D_{30} = *Thickness (in hundredths of a millimetre) of sphere 0·4 grams in weight after pressing in parallel plate plastimeter at 100° C. for 30 minutes.*

Ev = *Volume in ccs. extruded in 1 hour at 90° C.*

TABLE A (ii)

Plasticity of Air-dried Crêpe

Sample No.	Time of mastication	Time of mixing.	Raw rubber	Masticated rubber.		Rubber-sulphur mixing 90 10	
			D_{30}	D_{30}	E_v	D_{30}	E_v
	mins.	*mins.*					
1207	22½	10½	190	83	7·3	72	12·5
1209	21½	10	182	84	6·6	72	10·7
1211	20	10	187	88	6·3	74	10·0
1213	18½	10¼	166	88	6·9	76	11·7
1219	17½	8½	189	90	4·9	79	9 0
1220	21	9½	169	83	9·5	69	15 6
1223	20½	10	175	86	6·2	75	10·4
1225	21½	10	172	82	7·0	70	12·8
1228	25	11	173	76	11·4	·66	17·5
1229	22½	11	163	77	11·2	69	16·9
1232	22	10	169	81	7·3	71	12 3
1234	23	10	190	85	5·7	73	10·3
1235	25	11	180	79	8 6	65	13 4
1236	24½	12	180	84	6 8	73	10·7
1240	24	11	174	81	8·5	69	13·4
1241	28½	11½	166	75	11·4	62	18 7
1244	21	10	175	85	6·2	75	10·4

D_{30} = *Thickness (in hundredths of a millimetre) of sphere* 0 4 *grams in weight after pressing in parallel plate plastimeter at* 100° *C for* 30 *minutes*

E_v = *Volume in ccs extruded in* 1 *hour at* 90° *C*

TABLE A (iii)

Plasticity of Machine-dried Crêpe.

Sample No	Time of mastication	Time of mixing	Raw rubber	Masticated rubber.		Rubber-sulphur mixing 90 10.	
			D_{30}	D_{30}	E_v	D_{30}	E_v
	mins	*mins*					
1210	18½	8½	161	79	9·8	70	14·4
1212	22¼	10¼	168	71	9·3	70	14·8
1216	24	11	144	70	17·4	59	26·4
1218	16	7	165	88	6·6	76	11·7
1221	16½	7½	165	83	7·5	70	14·0
1224	23	10	182	81	8·1	70	13·6
1233	22	10½	174	81	7·1	74	13·3
1237	24½	11	172	85	8 8	71	12·2
1242	25	12	158	76	10·9	65	19·0
1245	28	13	156	77	12·0	64	15·2

D_{30} = *Thickness (in hundredths of a millimetre) of sphere* 0·4 *grams in weight after pressing in parallel plate plastimeter at* 100° *C. for* 30 *minutes.*

E_v = *Volume in ccs. extruded in* 1 *hour at* 90° *C.*

(3) *Mean Values*

The mean results for each form of rubber are as follows:

Form of rubber.	No of samples tested.	Time of mastication.	Time of mixing.	Raw rubber.	Masticated rubber.		Rubber-sulphur mixing 90 : 10.	
				D_{30}	D_{30}	E_v	D_{30}	E_v
		mins	*mins.*					
Smoked sheet .	12	23·3	10·3	169	79	8·5	67	14·8
Air-dried crêpe .	17	22·3	10·5	177	83	7·5	71	12·4
Machine-dried crêpe .	10	21·9	10·2	164	80	9·4	69	15·0

D_{30} = Thickness (in hundredths of a millimetre) of sphere 0·4 grams in weight after pressing in the parallel plate plastimeter at 100° C. for 30 minutes.
E_v = Volume in ccs. extruded in 1 hour at 90° C.

The above figures refer to arithmetical means except in the case of the extrusion figures which refer to the logarithmic means. The reason for this difference in the treatment of the extrusion figures as compared with the others is that the means of the extrusion figures are calculated from widely different values and the ratio between results is of importance and not the arithmetical difference between them.

There is little difference between the three forms of rubber as regards the time of masticating and mixing for a fixed power consumption. In the other tests the air-dried crêpe is somewhat less plastic than the smoked sheet and the machine-dried crêpe.

(4) *Variability*

Curves showing the frequency of distribution of plasticities of the different forms of rubber when mixed with sulphur are shown below (Fig. 4).

Along the horizontal axis is plotted the plasticity. For this purpose the plasticity values found have been separated into seven groups. Proceeding from left to right each group represents an equal logarithmic increase in plasticity on the previous group, equivalent to an actual increase in plasticity of 20 per cent. on the previous group. The percentage of the total number of samples tested occurring in each group is shown by the height of the vertical axis. In general the higher the curve the more

uniform is the distribution of plasticities, and the more the curve lies to the right the more plastic is the rubber.

These curves show very clearly that the plasticity of machine-dried crêpe is more uniform than that of the other forms of rubber.

(5) *Relation between Plasticities of Raw, Masticated and Mixed Rubber*

It is of importance to determine whether there is a fixed relation between the plasticity of the rubber in the

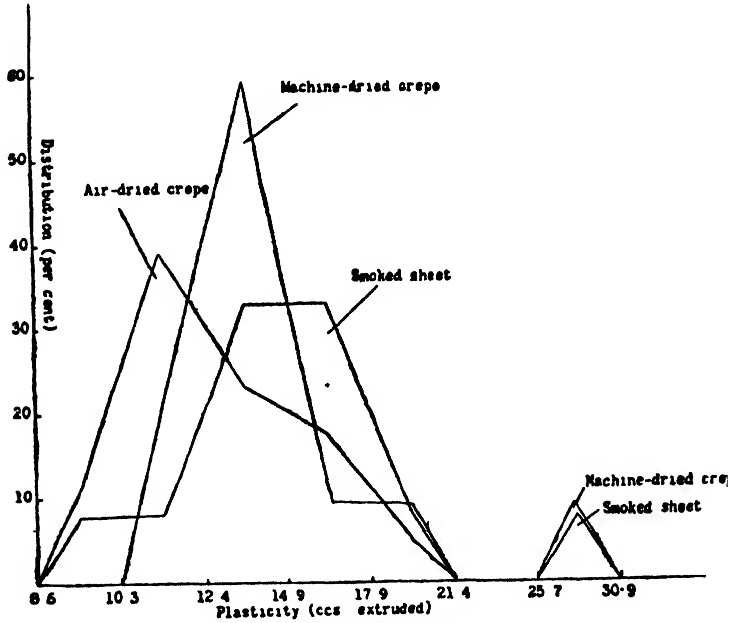

FIG. 4.—Plasticity frequency distribution curves.

raw state and of that of the masticated rubber or of the rubber mixed with sulphur. If there is such a relation the procedure employed for the determination of plasticity can be greatly simplified by testing the raw rubber only.

In Fig. 5 the percentage deviation of each D_{30} result from the average value for the set has been plotted for the raw, masticated and mixed rubbers. Three groups of three curves are shown, the curves in each group referring to raw, masticated and mixed rubber. The first group deals with smoked sheet, the second with air-dried crêpe, and the third with machine-dried crêpe. It will be seen

that the three curves in each group have approximately the same outline; from which it can be concluded that a rubber which is distinctly more plastic than the average in the raw state will probably be more plastic than the average when masticated or mixed with sulphur under the conditions of these tests.

Similarly a rubber which is distinctly less plastic than

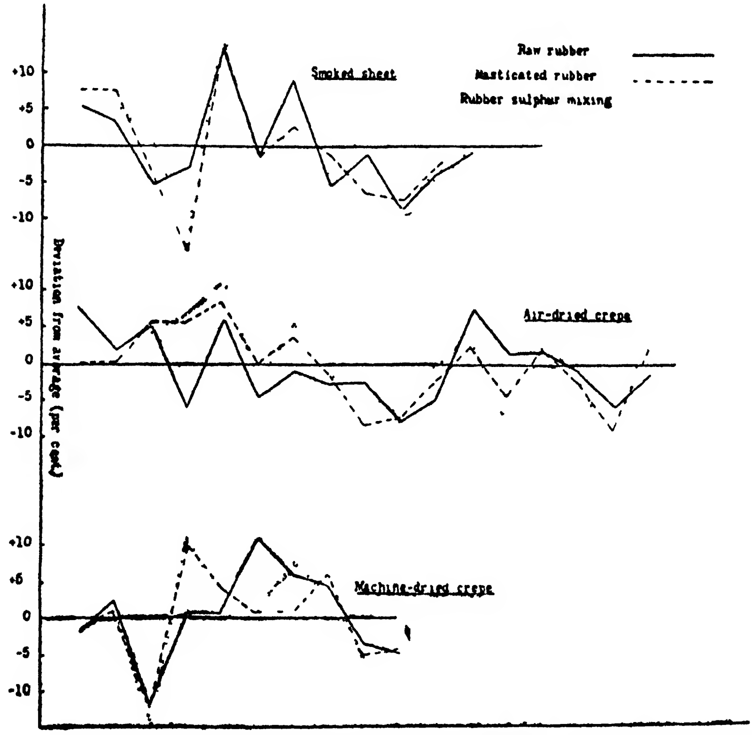

FIG. 5.—Comparison of variation in plasticity (D_{80}) of raw and masticated rubber, and of rubber sulphur mixing.

the average in the raw state will probably be less plastic than the average when masticated or mixed with sulphur. There are, however, exceptions. Consequently the plasticity of the rubber in the raw state is not an infallible guide to that of the masticated or mixed rubber. For the present, therefore, it is necessary to continue testing not only the raw rubber, but also the milled rubber.

The variations in the plasticity of the masticated rubber are generally of the same magnitude and of the same order as those of the rubber mixed with sulphur. This

is more clearly shown in Fig. 6. These curves indicate the variability in plasticity of the masticated and mixed rubbers as determined by the rate of extrusion. Each curve for masticated rubber has a similar outline to the corresponding curve for mixed rubber. It is considered, therefore, that there is a fixed relation between the plasticity of masticated rubber and of the rubber mixed with

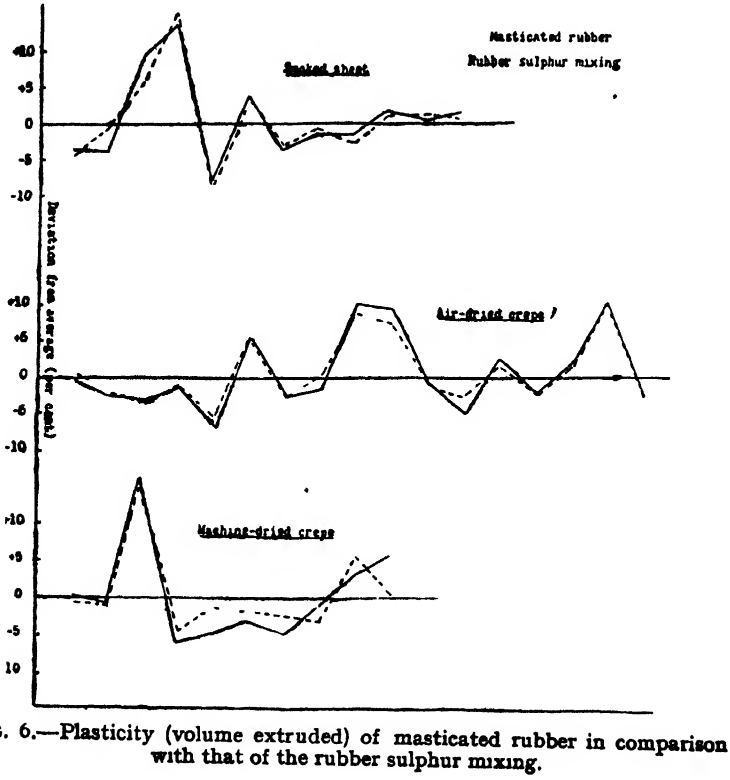

FIG. 6.—Plasticity (volume extruded) of masticated rubber in comparison with that of the rubber sulphur mixing.

sulphur and only in special circumstances in future should it be necessary to determine the plasticity of both masticated and mixed rubber.

(6) *Relation between time of Mastication and Mixing and Plasticity of Rubber*

It is to be expected that a tough viscous rubber will consume power at a greater rate during mastication and mixing than a soft plastic rubber. In the present samples there are many cases where this has occurred. On the

other hand there are notable exceptions for which no explanation can be offered at present.

(7) *Comparison of results given by Extruder and Parallel Plate Plastimeter*

Some investigators use the extruder and some the parallel plate plastimeter to determine the plasticity of rubber, but the results given by the two methods have not yet been correlated.

An expression has been deduced by Healey (*Trans. Inst. Rubber Industry*, 1926, p. 325) connecting the absolute viscosity of rubber with its thickness in the parallel plate plastimeter. From this expression it can be deduced that the D_{30} results, which in the experiments described in this report are very small compared with the initial thickness of the rubber, should be approximately proportional to the fourth root of the absolute viscosity of the rubber. On theoretical grounds the plasticity of the rubber as measured by the extruder might be expected to be inversely proportional to the absolute viscosity of the rubber. Therefore, the fourth root of the volume of rubber extruded in a given time should be approximately inversely proportional to the thickness of the rubber after pressing 30 minutes in the parallel plate plastimeter, i.e.

$$D_{30} \times \sqrt[4]{E_v} = K \text{ where K is a constant.}$$

The following table shows the value of the product $D_{30} \times \sqrt[4]{E_v}$ for the mean values of the three varieties of masticated and mixed rubbers.

Form of rubber.	Condition.	D_{30}.	E_v.	K.
Smoked sheet .	Masticated	79	8·5	135
" " .	Mixed with sulphur	67	14·8	131
Air-dried crêpe .	Masticated	83	7·5	138
" " .	Mixed with sulphur	71	12·4	134
Machine-dried crêpe	Masticated	80	9·4	140
" " .	Mixed with sulphur	69	15·0	136

It will be seen that in agreement with theory the value of K is approximately constant, being about 136. Similar values for K can also be calculated from the results given by individual samples, whether they are much more or much less plastic than the average.

Since the equation connecting D_{30}, E_{v} and K seems to hold, it may be concluded that:

(*a*) The time taken for a given volume of rubber to pass through the extruder under constant conditions is approximately proportional to the absolute viscosity of the rubber.

(*b*) The thickness of the rubber after pressing in the parallel plate plastimeter is approximately proportional to the fourth root of the absolute viscosity of the rubber as long as the final thickness is small compared with the initial thickness of the rubber.

From these two conclusions it may be further deduced that both the extruder and the parallel plate plastimeter can be used satisfactorily for the determination of plasticity, but that the extruder is much more sensitive to differences in plasticity and is, therefore, distinctly more useful for research purposes.

It has not been customary so far to express the plasticity of rubber in terms of absolute units. This has much to commend it, because it would enable all results to be expressed in the same units. So far it has not been possible to arrive at absolute units from the results given by the extruder. If, however, the absolute viscosity of the rubber is calculated from the results given by the parallel plate plastimeter, the apparatus factor for the extruder can be calculated and thenceforward all results can be expressed in terms of absolute units. It is proposed to adopt this method of expressing results as soon as possible.

II. Vulcanisation Tests in a Rubber-sulphur Mixing

The mixing consisted of rubber and sulphur in the proportion 90 : 10. All the samples were vulcanised for 100 minutes at 148° C. in steel moulds, in an autoclave under hydraulic pressure. The time of vulcanisation required to give an elongation of 775 per cent. when stretched under a load of 1·04 kgs./sq. mm. on the Schopper machine was calculated by assuming that the elongation decreased by 4 units for an increase of 1 minute in time of vulcanisation. Sample No. 1222 was vulcanised beyond the optimum at 100 minutes and was, therefore, vulcanised

for 75 minutes, and the correct time of vulcanisation calculated. The results obtained are given in the following table.

TABLE B

Time of Vulcanisation in Rubber-sulphur mixing

Sample No.	Tensile strength.	Elongation at load of 1·04 kgs./sq. mm.	Slope.	Calculated time of vulcanisation.
	lb./sq. in.	*per cent.*		*mins.*
		Smoked Sheet		
1208	2,240	810	37	109
1214	2,010	823	34	112
1215	1,150	905	—	132
1217	2,130	835	38	115
1222	2,380	750	38	80
1226	2,080	870	38	124
1227	2,270	828	39	113
1230	2,240	846	38	119
1231	2,410	815	38	110
1238	1,790	911	39	134
1239	1,690	923	40	137
1243	1,990	879	38	126
		Air-dried crêpe		
1207	2,050	824	34	112
1209	1,940	885	35	128
1211	2,160	865	34	123
1213	1,970	858	35	121
1219	1,590	904	37	132
1220	1,700	904	38	132
1223	1,660	926	37	138
1225	1,910	873	37	125
1228	1,740	926	36	138
1229	1,710	944	37	142
1232	2,150	860	37	121
1234	2,340	818	36	111
1235	1,850	914	36	135
1236	2,210	830	37	114
1240	1,510	976	39	150
1241	2,000	912	36	134
1244	2,010	886	36	128
		Machine-dried crêpe		
1210	1,580	917	35	136
1212	1,980	876	35	125
1216	1,260	845	37	118
1218	2,190	854	38	120
1221	1,730	889	38	129
1224	2,270	779	37	126
1233	2,070	858	36	121
1237	2,180	853	36	120
1242	1,940	930	36	139
1245	2,220	855	34	120

III. Vulcanisation Tests in a Zinc-oxide-accelerator Mixing

The mixing consisted of 90 parts of rubber, 5 sulphur, 5 zinc oxide, and 1 diphenylguanidine. It was vulcanised for 25 minutes at 148° C. and tested 24 hours later.

This mixing was selected because the results obtained on vulcanisation are affected by the fatty acids usually present in rubber. The investigations of the technical staff of the Scheme have shown that for this mixing the mechanical properties of the vulcanised rubber are comparatively poor when the amount of fatty acids present falls below a certain value (Martin and Davey, *J. Soc. Chem. Ind.*, 1925, **44**, 317T). The zinc oxide and accelerator together effect a marked improvement in the mechanical properties of the vulcanised mixing, but when the surface concentration of the zinc oxide falls below a certain amount a portion of the accelerator is unable to associate itself with the oxide and the maximum benefit is not obtained. In the absence of fatty acids the zinc oxide is badly dispersed and a large quantity is necessary to ensure the presence of the required minimum surface concentration. It is found that mixings containing 5 parts of zinc oxide per 90 of rubber require the presence of fatty acids to promote dispersion and ensure the necessary surface concentration, but in the presence of 10 or more parts of zinc oxide the packing is sufficiently close to give good vulcanisation results in the absence of fatty acids.

The mixing selected is, therefore, one which should indicate whether variation in the amount of fatty acids in first grade rubber is of importance in connection with mixings containing organic accelerators and small proportions of zinc oxide.

The results given in the following table show that all these samples of Ceylon estate grades contain sufficient fatty acids to ensure excellent dispersions of the zinc oxide.

TABLE C

Mechanical Properties of Zinc-oxide-accelerator Mixing

Smoked sheet

Sample No	Tensile strength.	Elongation at load of 1 04 kgs /sq mm.	Slope.
	lb /sq in.	*per cent*	
1208	2,990	564	32
1214	2,990	568	31
1215	2,880	573	34
1217	2,940	575	33
1222	2,800	581	31
1226	3,120	577	32
1227	2,920	578	31
1230	2,970	581	31
1231	2,950	591	31
1238	2,900	587	32
1239	2,690	564	31
1243	3,230	568	31

Air-dried crêpe

1207	2,960	580	34
1209	3,080	586	30
1211	2,900	586	31
1213	2,990	580	31
1219	2,850	609	32
1220	3,090	586	30
1223	2,960	591	31
1225	2,990	581	30
1228	2,690	586	30
1229	3,090	577	30
1232	3,080	586	31
1234	3,090	567	30
1235	2,940	581	30
1236	3,140	580	32
1240	2,990	589	32
1241	2,970	582	31
1244	3,080	597	30

Machine-dried crêpe

1210	2,960	566	30
1212	3,000	559	31
1216	2,970	580	30
1218	2,870	595	32
1221	3,240	566	31
1224	3,280	575	30
1233	3,120	586	30
1237	2,980	574	32
1242	3,300	575	30
1245	3,150	582	29

PEAT AND PEAT WAX FROM CHATHAM ISLANDS

The peat which is the subject of this report was sent to the Imperial Institute by the Secretary to the New Zealand Government Office in London. A communication on the same subject was also received from the Mines Department, Wellington.

In a communication from the Dominion Laboratory of Wellington, New Zealand, it was stated that a considerable percentage of a dark wax could be extracted from the peat by chloroform and the Dominion Analyst advised that, as the question of the value of the extracted wax and the uses to which it could be put could not be well ascertained in New Zealand, the matter should be referred to the Imperial Institute. It was also mentioned that thousands of acres of the peat deposits occur near Kaingaroa, conveniently near to good sea-ports.

Results of Examination

The material as received consisted of about 90 lb. of a dark-brown, fairly dry peat.

In order to secure a quantity of the wax sufficient for valuation purposes it was necessary to treat a fair quantity of the peat with a solvent, and experiments were therefore made in order to determine the most suitable solvent for the purpose.

In the preliminary analyses made in New Zealand chloroform was used; but, as it is unlikely, on account of cost, that this solvent could be used commercially for extracting the wax, a series of experiments was made at the Imperial Institute using other solvents, i.e. petrol-ether, acetone and benzene, in comparison with chloroform. These extractions were all carried out under the same conditions and hence are comparable one with another, but further experiments showed that the quantity of wax extracted by any given solvent in a given time varied according to the conditions of the experiment. In the present series of experiments successive extractions were made until the quantity of wax removed by the last 6

hours' hot treatment amounted to less than 1 per cent. of the original peat.

Extractions

Solvent.	Petrol-ether.	Acetone.	Chloroform.	Benzene.
	per cent.	*per cent.*	*per cent.*	*per cent.*
Total extract from peat containing 9·8 per cent. moisture .	3·35	14·88	27·15	24·86
Total extract calculated on the dry peat	3·71	16·50	30·10	27·56
Time of extraction (hours) . . .	17	21	40	40

The above hot extractions were made in a laboratory Soxhlet apparatus and the extracts, after removal of the solvents, were dried to constant weight in a steam oven. The wax-like residues so obtained were as follows:

Petrol-ether extract.—A hard, dark-yellow wax.

Acetone and Chloroform extracts.—Brittle, dark-brown waxes.

Benzene extract.—A black, brittle wax.

The variation in the nature of the wax extracted by the different solvents shows that the peat wax is not a single substance but a mixture of waxes.

It will be observed that the peat has an unusually low content of moisture, a very desirable feature in a substance which is to be subsequently treated with a solvent not miscible with water.

The peat wax obtained bore some considerable resemblance to montan wax, a substance produced in large quantities in Germany from lignite.

In the extraction of montan wax from lignites containing a high percentage of moisture, better yields are stated to be often obtained by employing a mixture of solvents such as benzol and alcohol, or benzene, methyl alcohol and acetone, as these mixtures can dissolve a considerable amount of water without losing their solvent power for the wax. Although the moisture content of the present sample was comparatively low, it seemed worth while to carry out experiments using the following mixtures:

(1) Benzene and alcohol 1 to 1.

(2) Benzene, methyl alcohol and acetone 2 : 1 : 1.

The second mixture gave only slightly better results than did acetone alone, whilst with benzene and alcohol

the results were higher than with benzene alone, but the extraction was very much slower and it was necessary to extract the peat for approximately 90 hours before all the wax was removed.

The results were as follows :

	Benzene and alcohol 1 : 1. *per cent.*	Benzene, methyl alcohol and acetone 2 : 1 : 1. *per cent.*
Total wax extracted	31·3	16·1
Total wax extracted calculated on the dry peat	34·6	17·9

From the above experiments it appeared, on the whole, that benzene would be the most suitable solvent for the extraction of the wax from the peat. Chloroform under the same conditions of experiment gave higher yields but would be too expensive to use on a large scale, whilst the mixture of benzene and alcohol acted very slowly under the conditions employed.

The yield of wax from the peat is high compared with that recorded for some German peats quoted below :

Content of Crude Wax of some German Peats[1]

	Per cent on dry peat.
Frazenbader Moor	4·1
Aiblinger Moor (Oberbayern)	7·5
Kolber Moor Upper layer	6·7
„ „ about 1 metre deeper . . .	7·8
„ „ „ 1 „ „ . . .	7·0
„ „ „ 1 „ „ . . .	8·1
Feilenbacher Moor	5·5
Kochel	4·8

[1] *"Öle und Fette," Ubbelohde, Hartmann & Goldschmidt, Vol. 4, p.* 743.

The crude wax obtained by extracting the Chatham Islands peat with benzene consisted of hard, brittle, dark-brown material, rather lighter in colour than a sample of commercial crude, unbleached montan wax, and when ground had not the peculiar characteristic smell of the latter wax.

As it seemed possible that the Chatham Islands peat wax might be used as a substitute for montan wax, attention was given to the points of similarity of the two waxes.

In the following table are given some properties of this peat wax as compared with a commercial sample of

crude montan wax examined at the Imperial Institute, and with values given for a peat wax from Oldenburger moor peat.

	Wax from Chatham Islands Peat prepared at the Imperial Institute.	Wax from Chatham Islands Peat tested in Dominion Laboratory.	Montan wax.	Wax from Oldenburger moor peat.[1]
Melting point.	70° to 74° C.	73° C.	80° to 87° C.	74° C.
Saponification value .	120	146·4	84	116
Acid value .	55	40·4	25	51

[1] "*Öle und Fette*," *Ubbelohde, Hartmann & Goldschmidt, Vol.* 4, *p.* 744.

The present sample thus resembles, in many of its physical properties, the Oldenburger peat wax.

It may be remarked that the physical constants recorded for montan wax vary considerably according to the source of the wax and the method of preparation. The following are recorded values from some different sources :

	Crude montan wax prepared from a lignite from Mid-Germany [1]	Montan wax [2]
Melting point . .	81° to 82° C.	75° to 80° C. crude wax.
Acid value . .	28·6	20·9 for crude wax to 61·2 for distilled wax.
Saponification value .	97·8	—
Ester value . .	—	From 6·3 for distilled wax to 172 5 for crude wax.

[1] "*Braunkohlen Archiv.*," 1926, *No.* 12.
[2] "*Öle und Fette*," *Ubbelohde, Hartmann & Goldschmidt*, p 750

Both the Chatham Islands peat wax and the crude montan wax behaved in a similar manner on treatment with alcohol. When the wax was boiled with alcohol some passed into solution and left a dark, insoluble residue. On cooling the hot alcoholic solution, a quantity of light yellow, wax-like material separated out. A soft, brown, sticky, resinous substance was obtained by distilling the alcohol from the cold alcoholic solution which remained after separating the light yellow wax. The proportion of this resinous material was higher in the case of the peat wax than with the montan wax.

Attempts to bleach the crude peat wax by means of mineral acids were not successful. Thus, warming with nitric acid appeared to cause some nitration, whilst warm sulphuric acid (3·4 to 1) had little effect.

Peat Residue.—With a view to determining the fuel value of the peat which remained after the extraction of the wax, an examination was made on a sample from which all the solvent had been carefully removed.

The material gave the following results on analysis:

	Per cent
Fixed carbon	23·98
Volatile matter	50·69
Ash	15·92
Moisture	9·41
	100 00
Sulphur (S) *per cent.*	0 27
Calorific value.	
Calories	4,885
British Thermal Units	8,793

The above figures indicate that the peat residue would form a useful fuel. Owing to the fact, however, that the peat would probably have to be reduced to a fairly fine condition before extraction (say knobs about 1 cm. in diameter), a special form of grate might be required to burn the peat residue.

It is possible that by distilling the extracted peat a further yield of wax might be obtained, together with oils suitable for solvent purposes.

Commercial Extraction of Peat Wax

If it is intended to recover the wax from the Chatham Islands peat on a commercial scale, it will be necessary to consider carefully possible processes for extraction. In this connection it would be useful to consider the methods which have been used in Germany for recovering montan wax from lignite. Details of these processes are, however, too lengthy to include in this publication, but those interested will find a useful summary of the methods employed in an article by Dr. Sedlaczek (*Kunstoffe*, 1924, **14**, 1), whilst details of current practice at one important works in Germany are given in a recent paper by Sir R. Redmayne on "The Occurrence, Working and Treatment of Brown Coal with Special Reference to German Practice" (*The Fuel Economist*, Dec., 1926).

Solvents.—It is evident that it will be necessary to

exercise economy in regard to the solvent selected for use and in this connection the possibility of using a variety of kerosene might be considered.

Some preliminary experiments carried out at the Imperial Institute indicated that ordinary kerosene (B.P. 150° C. to 280° C.) extracted the wax almost as efficiently as did the other solvents referred to in this report (see p. 244). Difficulty was encountered, however, in freeing the extracted wax from the solvent owing to the rather high boiling point of the latter and the risk of damaging the wax by overheating.

It should be mentioned that the crude wax obtained at the Imperial Institute by the use of this solvent differed from that yielded by extraction with benzene, being much blacker and less wax-like and apparently much resembling the "bitumen" recovered from German lignite.

It might be worth while to continue these experiments and use kerosene of a rather lower boiling range, say between 100 and 150° C.

Plant Required.—With a view to obtaining an approximate idea of the more essential plant which would be required for the commercial extraction of the wax, the Imperial Institute consulted two well-known firms manufacturing chemical extraction plants, who made tentative suggestions regarding the most suitable form of plant to be employed, but suggested that before deciding details it would be advisable to have carried out a number of small-scale commercial trials.

Commercial Valuation of the Wax

A large quantity of the Chatham Islands peat was extracted with benzene and the wax recovered was divided into a number of portions which were submitted to users and merchants dealing in crude montan wax, with the suggestion that it might prove a substitute for the latter.

One firm, with special experience in the marketing of such waxes, stated that peat wax was not unknown to them, but it had not yet been on the market. They considered that it might serve as a substitute for crude black montan wax, but it could not replace the refined quality, as all efforts to produce from peat wax a material

similar to bleached montan wax had so far been unsuccessful.

They suggested that, in order to be successfully marketed, the wax should be supplied at about £25 per ton, c.i.f. English ports, and stated that they would be glad to go into the question of marketing the wax. They estimated that probably between 500 and 2,000 tons per annum could eventually be disposed of to trades now using black montan wax. Such a trade, however, would need to be built up by propaganda and trade introductions.

A sample of the peat wax was also submitted to a consultant who has specialised in waxes and he reported that the Chatham Islands wax could certainly serve as a substitute for black montan wax.

Certain varieties of montan wax are used in the manufacture of gramophone records, but a firm to whom the present wax was submitted reported that the material was too brittle to be used for this purpose.

A maker of polishes reported that material of the quality represented by the sample of peat wax submitted could be used in the preparation of boot polishes.

Summary and Conclusions

Representative portions of the peat from the Chatham Islands examined at the Imperial Institute were found to contain about 25 per cent. of a crude wax extractable by benzene or similar solvents. This represents an unusually high yield, as the majority of dry peats give only 6 to 8 per cent. of wax, whilst the quantity obtained from lignite is rarely more than half the amount obtained from the Chatham Islands peat.

Other experiments showed that benzene, or mixtures of benzene and alcohol, were almost as efficient as chloroform for extracting the wax from the peat, and showed considerable advantage in regard to cost. Preliminary trials indicated that kerosene might possibly be used, but further work would be required before this could be definitely ascertained.

Experiments made at the Imperial Institute showed that the peat wax in many respects resembled the crude montan wax produced in Germany from lignite, but was

inferior to that material, since, in common with most peat waxes, it could not readily be bleached.

Samples of the peat wax were submitted to brokers and users of montan wax. The brokers expressed the opinion that the wax could be used as a substitute for black montan wax. A similar opinion was also given by a consultant who specialises in waxes. Manufacturers of boot and other polishes using montan wax expressed the opinion that they would be able to use the peat wax, but asked for larger samples for fuller trials.

The brokers estimated that a market might be found eventually for between 500 and 2,000 tons per annum, but were of the opinion that the wax would have to be sold at not more than £25 per ton in the United Kingdom.

An analysis of the peat remaining after the extraction of the wax showed that this material would form a useful fuel.

It is suggested that, before selecting a plant, trials should be carried out in a small-size commercial unit belonging to the plant manufacturers which is available for the purpose.

ARTICLE

TANNING MATERIALS OF THE BRITISH EMPIRE

PART I

For some time past the question of future supplies of vegetable tanning materials has been a matter of some anxiety in the leather industry, not only of the United Kingdom but throughout the world. During the war there was an enormous demand for such products, but certain countries were temporarily cut off from the world market, and the normal disposal of raw material underwent a considerable change. This dislocation of trade has gradually been overcome, and the consumption of tanning materials in the last two or three years may be taken as an index of the future requirements of the industry. These years show a steadily increasing consump-

tion, and attention has been directed to a consideration of the world's resources with regard to the future.

From the accompanying table, for which the Imperial Institute is indebted to Dr. Snow, Manager of the United Tanners' Federation, it will be seen that in the United Kingdom more than half the tanning materials consumed, expressed as tanning units, are derived from foreign countries, the largest item being quebracho extract from the Argentine. There is consequently a large field for the expansion of Empire production, not only in providing the additional tanning units required in the future, but in rendering the leather industries of the Empire as far as possible independent of foreign supplies. The Advisory Committee on Tanning Materials of the Imperial Institute are taking steps to encourage the production of tanning materials in British countries and to introduce new tanstuffs that are of promise.

The present article has for its object a brief review of the tanning materials of the Empire, including those in established use and those worthy of consideration as new articles of commerce. The well-known materials will be described in the following order: barks, woods, leaves and fruits; a later section will be devoted to lesser known materials of these groups that are of interest.

The first part of the article now published deals with the following barks: wattle, mangrove, mallet, hemlock, avaram and babul barks.

Wattle Barks

Wattle bark is one of the most valuable and extensively employed tanning materials of the British Empire, and is meeting with increasing popularity with British tanners. At the suggestion of the United Tanners' Federation the Imperial Institute made enquiries a few years ago as to the possibility of extending the production of wattle bark within the Empire, and again more recently the question of fresh sources of supply has been considered by the Imperial Institute Advisory Committee on Tanning Materials. It has been shown that several countries possess suitable conditions for growing bark of good quality, but that the establishment or development of an export

Consumption of Vegetable Tanning Materials in Great Britain and Ireland

—			1913.			1922.			1925.		
Material.	Country of Origin	Tannin Content.	Weight.	Tanning Units.	Value.	Weight.	Tanning Units.	Value.	Weight.	Tanning Units.	Value.
		Per cent.	Tons.	Tons	£	Tons.	Tons.	£	Tons.	Tons	£
Wattle bark . . .	S. Africa	34	10,720	3,650	80,000	25,500	8,670	242,000	20,260	6,890	207,000
Myrobalans . . .	India	32	27,160	8,830	171,000	24,570	7,860	180,000	26,970	8,630	315,000
Wattle extract . .	S. Africa	60	—	—	—	6,500	3,900	149,000	7,840	5,700	170,000
Gambier . . .	Straits Settlements	36	4,680	1,680	130,000	3,950	1,420	139,000	2,100	760	135,000
Larch bark . . .	Gt. Britain and Ireland	10	800	80	60,000	800	80	70,000	10,000	1,000	60,000
Oak bark . . .		11	12,000	1,320		10,000	1,100				
Myrobalans extract . .	India	26–60[1]	1,200	560	13,000	1,400	650	27,000	920	500	25,000
Hemlock extract . .	Canada	60	300	180	4,000	300	180	6,000	—	—	—
Chestnut extract . .	U.S.A.	29	4,900	1,450	46,000	500	150	13,000	1,800	520	56,000
" " . .	France	27	35,800	9,580	430,000	18,600	5,020	335,000	11,070	2,990	192,000
" " . .	Italy	27	7,000	1,900	88,000	6,900	1,860	137,000	12,530	3,380	213,000
Quebracho extract . .	Argentine	63	8,100	5,100	142,000	10,700	6,740	259,000	24,470	15,410	488,000
Sumach	Italy	28	7,300	2,040	74,000	5,150	1,440	71,000	4,760	1,330	127,000
Valonia	Turkey and Greece	31	17,100	5,310	161,000	5,300	1,640	63,000	9,380	2,906	115,000
Valonia extract . .	Turkey	64	1,100	700	26,000	460	300	16,000	240	160	8,000
Algarobilla . . .	Chile	47	—	—	—	900	420	13,000	100	47	1,000
Miscellaneous materials .			1,050	400	10,000	1,900	700	23,000	1,000	300	13,000
Miscellaneous extracts .			3,000	1,300	39,000	1,100	330	26,000	3,000	1,200	53,000
Total . .			142,210	44,080	1,474,000	124,530	42,460	1,769,000	136,440	51,723	2,178,000

[1] Liquid extract, 26 per cent.; solid extract, 60 per cent.

industry at the present time would in many cases be hampered by the existing high freights.

Wattle bark is produced from species of *Acacia*, of which the most important commercially is the black wattle (*A. decurrens* var. *mollis* Willd. = *A. mollissima* Willd.). The wattles, or mimosas as they are sometimes called, which are employed as a source of tanning bark, are of Australian origin, and certain of them have been introduced into other parts of the Empire, including Natal and elsewhere in South Africa, as well as Kenya and India. The greatest development in the wattle bark industry has taken place in Natal, where the conditions are specially favourable to the production of the bark, the climate having proved eminently suitable to the black wattle, and a plentiful supply of cheap labour being available. Moreover, Natal has been fortunate in finding a ready local market for the wood (left after the bark has been stripped), which is largely employed for mine props and as fuel. This question of the utilisation of the wood is a most important one in determining the success of a wattle bark industry, and a recent estimate of the returns from a plantation in Natal show that of the total receipts 56 per cent. was derived from the sale of bark, 33 per cent from mine props and 11 per cent. from fuel.

Many references have been made in this BULLETIN to wattle bark and its production, and also to the possible commercial utilisation of the by-products of the industry. The following are the principal articles dealing with the subject: "Production and Utilisation of Wattle Bark," 1908, **6**, 157; "Wattle Barks from the Transvaal and the East Africa Protectorate," 1910, **8**, 245; "The Utilisation of Wattle Bark," 1911, **9**, 116; "Black Wattle Bark from the East Africa Protectorate," 1913, **11**, 402; "Destructive Distillation Trials with Black Wattle Wood," 1916, **14**, 570; "The Wattle-bark Industry of Natal," 1916, **14**, 599; "Wattle Bark and Wood" (Paper-making trials), 1917, **15**, 496; "Black Wattle Wood Ash from the East Africa Protectorate," 1919, **17**, 281; "Wattle Bark from Ceylon," 1923, **21**, 466; "The Cultivation of Black Wattle," 1923, **21**, 607.

Wattle, like quebracho, is an astringent catechol

tannin. It lends itself particularly to sole-leather manufacture, but can also be used very successfully for light leather. Although classed as a rapid tanning material, it is stated that the tannin does not penetrate quite so quickly as quebracho, but the colour of the leather is much less red than that obtained from many other catechol tans. The tanning liquors produce very little acid on fermentation, and in consequence do not plump well; wattle therefore makes a good blend with acid-producing tanning materials, such as myrobalans. Wattle leather is firm and durable.

Union of South Africa.—Since the introduction of wattles from Australia in 1880 their cultivation in South Africa has been so greatly extended that the production of wattle bark has become one of the chief industries of the country. The kind cultivated in South Africa is the black wattle, *Acacia decurrens* var. *mollis* Willd. (= *A. mollissima* Willd.), which was selected, after many experiments with the best Australian wattles, as being hardier, more suited to the climate, and furnishing on the whole a larger yield of bark than the other species, although the bark contains less tannin than that of the golden wattle, *A. pycnantha* Benth.

The trees are planted out in rows usually about 9 to 12 ft. apart, and 6 ft. apart in the line. The rotation was formerly from 6 to 7 years, but according to T. R. Sim it now varies from 7 to 12 years, and the trees would appear to be generally felled in the 8th year. The longer rotation is found to be more remunerative in normal times, for it allows the timber, which not many years ago was considered a waste product, to be utilised as mine props, and this outlet now constitutes a large and important industry. In some circumstances, however, it pays to cut the trees at an earlier stage, and it is understood that in a recent season, owing to the scarcity of the bark and consequent high prices, quite young trees, 5 to 6 years old, have been stripped. The returns per acre vary according to locality, but are stated (T. R. Sim) to be generally about 4 tons of bark and 20 tons of timber for an 8-year-old crop.

The area under cultivation, according to the last Agricultural Census of Plantations and Indigenous Forests in 1921, was as follows :

	Acres.
Natal	222,778
Transvaal	49,289
Cape of Good Hope . .	15,110
Orange Free State . .	1,249
Total . . .	288,426

Complete statistics for the years subsequent to 1921 are not available, but it is understood that during the next year or two the total area devoted to wattle was appreciably reduced, although it has shown a tendency to recover in later years. It is stated that about 30 per cent. of the wattle plantations are owned by large syndicates which are their own exporters or which manufacture extract.

Although prior to the war the United Kingdom received the larger proportion of the South African exports, amounting in 1913 to nearly 70 per cent., most of the bark was re-exported to Germany, where it was largely converted into extract. Hence Germany at that time was by far the Union's largest customer. With the advent of the war, however, when the supply of Turkish valonia and other commercial sources of tannin were cut off, British tanners were compelled to replace them largely by wattle bark and its extract, and thus the high value of wattle bark as a tanning material became more widely recognised. There can be no doubt that the general experience gained has resulted in a greater proportion of wattle being employed in British tanning.

In the accompanying table, showing the exports of wattle bark from the Union of South Africa since 1914, it will be observed that during the years 1921 to 1925 Germany again became the largest consumer of Natal bark. Last year (1926), however, witnessed a marked fall in the direct shipments to Germany, but it may be pointed out that a very large proportion of the bark exported to Belgian and Dutch ports eventually finds its way to Germany, and this fact must be borne in mind in considering the figures shown in the table.

A more recent development in Natal has been the production of wattle bark extract, which was not seriously commenced on a commercial scale until 1916, when an extract factory was erected in Pietermaritzburg, and was followed soon afterwards by factories in other parts of Natal. To-day the largest manufacturer of solid wattle extract possesses three up-to-date, fully-equipped extract factories, collectively capable of producing 24,000 tons of extract per annum and each able to deal with 25,000 tons of green bark annually. The productive capacity of the other manufacturers in Natal is about 18,000 tons of extract a year. The rapid growth of the industry is shown by the accompanying table of exports (see next page).

During the last few years there has been a considerable decline in the market price of wattle extract, which is determined by that of quebracho extract, and an enquiry into the conditions of the industry was made in 1924 by the Board of Trade and Industries, Industries Division, Department of Mines and Industries, Union of South Africa. The following is a summary of the recommendations made: (*a*) A thorough survey of the whole country by the Forest Department; (*b*) the offer by the Government of substantial prizes to growers for the production, on a commercial scale, of bark with a high tannin content; (*c*) that an officer be detailed to watch the interests of growers, and especially to assist in establishing conditions for marketing on business lines, these conditions including credit from the Land Bank and the grading of bark; (*d*) the reduction of ocean freight on wattle extract; (*e*) a revision of the railway rates on bark and extract.

Natal wattle bark, in air-dried condition containing usually 10 to 12 per cent. of moisture, is shipped in bags or bales either as stick bark, chopped bark, compressed bark or shredded or ground bark. Bales of chopped bark take up a space of 85 cu. ft. per ton, compressed bark about 55 cu. ft. and ground bark 50 cu. ft. The percentage of tannin in the bark ranges from 30 to 45 per cent., with an average of about 33 per cent. The solid extract, which contains about twice as much tannin as the bark, occupies a space of about 40 cu. ft. per ton.

Exports of Wattle Bark from South Africa

Year.	United Kingdom	Australia.	United States	Germany	Japan	Belgium	Holland	Other Countries	Total.
Quantity in Short Tons (2,000 lb)									
1914	—	—	—	—	—	—	—	—	65,108
1915	33,966	8,496	1,540	—	3	—	—	826	44,831
1916	28,399	5,817	12,783	—	890	—	—	9,082	56,971
1917	25,508	9,041	3,138	—	1,965	—	—	6,623	46,275
1918	39,950	4,253	2,479	—	5,764	—	—	1,506	53,952
1919	20,809	6,946	20,291	—	5,937	1,810	2,620	4,909	63,322
1920	36,460	3,213	20,470	3,466	5,582	2,229	2,133	5,358	78,911
1921	14,298	3,169	6,777	38,188	10,685	1,449	2,781	2,595	79,942
1922	28,786	3,796	10,009	73,731	6,652	3,384	3,476	6,024	135,858
1923	34,444	9,113	13,074	36,269	8,323	4,601	5,761	9,077	120,662
1924	21,831	3,495	7,632	24,102	9,165	4,144	23,558	7,898	101,825
1925	20,427	1,720	9,832	30,320	7,364	12,003	18,548	11,060	111,774
1926	20,905	4,729	8,657	11,910	9,734	15,467	7,222	11,420	90,094
Value in £									
1914	—	—	—	—	—	—	—	—	286,399
1915	150,415	35,102	6,156	—	13	—	—	3,558	195,244
1916	129,287	24,772	53,570	—	4,063	—	—	43,172	254,864
1917	131,116	39,856	14,266	—	9,265	—	—	29,479	223,982
1918	218,484	19,472	12,232	—	29,700	—	—	7,332	287,220
1919	135,664	35,854	122,026	—	35,347	11,797	19,578	25,830	386,096
1920	325,697	23,653	168,647	23,160	44,467	18,127	16,455	42,309	662,515
1921	90,588	16,482	36,476	214,886	60,914	8,791	16,203	12,978	457,318
1922	173,925	21,033	55,657	433,400	41,390	18,571	19,808	36,158	799,942
1923	191,098	47,873	66,598	197,706	46,584	24,071	32,252	53,115	659,297
1924	128,432	20,537	43,623	132,876	52,574	24,830	134,242	46,858	583,972
1925	146,604	11,947	68,023	204,598	56,789	84,417	130,574	78,141	781,093
1926	143,411	30,629	54,588	74,191	64,725	103,993	46,168	75,065	592,830

Exports of Wattle Bark Extract from South Africa

Year	United Kingdom	Australia	United States	Germany	Japan	Belgium	Holland	Other Countries	Total
Quantity in Short Tons (2,000 lb)									
1916	491	—	—	—	—	—	—	—	491
1917	1,184	45	6	—	45	—	—	112	1,392
1918	3,564	292	—	—	133	—	—	180	4,169
1919	6,513	249	35	—	13	—	31	39	6,880
1920	7,541	310	713	—	217	59	17	641	9,498
1921	3,590	40	684	714	65	238	92	46	5,469
1922	6,534	74	—	4,131	68	465	393	510	12,175
1923	11,277	125	—	4,396	431	459	103	689	17,480
1924	8,178	88	143	4,531	212	1,025	898	1,972	17,047
1925	9,799	72	399	5,484	524	1,066	804	2,015	20,163
1926	7,552	90	111	7,300	353	1,832	646	1,388	19,272
Value in £									
1916	14,930	—	—	—	—	—	—	—	14,930
1917	42,202	1,600	168	—	1,550	—	—	4,000	49,520
1918	103,600	10,360	—	—	4,505	—	—	6,410	124,875
1919	204,440	7,094	1,089	—	1,300	—	940	1,223	216,086
1920	263,449	11,043	16,292	—	8,124	2,261	581	22,219	323,969
1921	72,296	697	18,444	12,595	1,550	4,501	1,872	854	112,809
1922	109,467	1,222	—	68,912	1,196	8,179	6,157	8,064	203,107
1923	168,788	2,011	—	68,527	7,182	7,296	1,623	10,657	266,084
1924	122,284	1,324	2,155	69,121	3,195	16,001	12,652	30,068	256,800
1925	158,528	1,131	6,472	90,761	8,547	17,252	13,013	32,364	328,068
1926	126,387	1,440	1,900	124,807	5,850	29,034	10,398	24,521	324,337

Commonwealth of Australia.—Australia, the home of the wattle, can boast of more than 400 indigenous species of *Acacia*. This country, which formerly afforded the only commercial source of the bark, has for some years produced an insufficient quantity for home consumption, and finds it necessary to import some 3,000 tons annually from South Africa.

The two most important Australian commercial species are (1) the golden wattle, *A. pycnantha*, which occurs principally in South Australia, and to a smaller extent in Victoria and the south-west of New South Wales, and (2) the more hardy black (or green) wattle, *A. decurrens* var. *mollis*, the species which gives the best results in the other States.

A. pycnantha provides one of the richest known tanning barks, analyses being recorded which show up to 50 per cent. of tannin in the air-dried material. The best commercial *A. pycnantha* bark, known as "Adelaide bark," contains on an average about 38 per cent. of tannin. Australian *A. decurrens* var. *mollis* bark contains from 31 to 39 per cent. of tannin. It is stated that the black wattle bark sold in Sydney is generally a mixture of the varieties *mollis* and *normalis* giving a tannin value of about 30 per cent., but that it sometimes contains a large proportion of the inferior silver wattle bark (*A. dealbata* Link), which usually contains not more than 20 per cent. of tannin.

Unlike the South African industry, that of Australia has been dependent on natural forests, where the trees are of different ages and often of mixed varieties, so that the bark has not the even quality of the South African product.

Since the year 1905 the output of tanning barks in Australia has gradually decreased. This decline has been due to the depletion of the forests by the general destruction of the trees and the consequent necessity of having to push further and further afield from the markets, since re-afforestation has not been practised to any extent. In view of the very favourable conditions under which the Natal industry is conducted, as regards environment, labour supply and market for the wood, the opinion has been expressed that Australian wattle bark can only hope to compete with Natal bark when some

mechanical means has been devised for stripping the bark or more profitable use is made of the by-products of the industry, or possibly only when both these conditions have been fulfilled.

The following tables show the amounts of tanning bark exported from the Commonwealth during the last five years for which figures are available, and also the quantities employed in the tanneries of each State.

Tan Bark—Exports from Australia, 1920–21 *to* 1924–25

—	Quantity.					Value.				
	1920–21	1921–22	1922–23	1923–24	1924–25	1920–21	1921–22	1922–23	1923–24	1924–25
	Cwts	*Cwts*	*Cwts*	*Cwts.*	*Cwts.*	£	£	£	£	£
United Kingdom	360	1	12	—	48	202	1	3	—	48
New Zealand .	56,360	17,047	12,718	5,278	4,061	39,356	11,927	8,299	3,263	2,372
Other British Possessions .	100	—	309	—	332	88	—	194	—	170
Germany . .	—	—	—	9,005	36,081	—	—	—	4,983	19,587
Other Foreign Countries .	8,400	822	4,490	3,318	2,272	7,084	534	2,220	2,172	1,155
Total . .	65,220	17,870	17,529	17,601	42,794	46,730	12,462	10,716	10,418	23,332

Note.—These exports include other tanning barks besides wattle bark, and during the last two years have consisted largely of mallet bark from Western Australia, which is not used extensively in Australian tanneries but is exported to Germany for extract making

Total Imports and Exports of Tan Bark, 1921–25

Year.	Imports.		Exports.		Excess of Imports.	
	Cwts.	£	*Cwts*	£	*Cwts.*	£
1920–21 .	48,100	20,002	65,220	46,730	17,120[1]	26,728
1921–22 .	34,328	15,954	17,870	12,462	16,458	3,492
1922–23 .	93,769	37,349	17,529	10,716	76,240	26,633
1923–24 .	73,941	28,672	17,601	10,418	56,340	18,254
1924–25 .	28,628	11,821	42,794	23,332	14,166[1]	11,511

[1] *Excess of Exports.*

Tan Bark used in the Tanneries of the Commonwealth

Quantity in Tons

—	New South Wales.	Victoria.	Queensland.	South Australia.	Western Australia	Tasmania.	Total.
1920–21 .	11,519	10,709	2,352 (1920)	1,437	794 (1920)	462 (1920)	27,273
1921–22 .	11,836	13,852	2,411 (1921)	1,329	924 (1921)	469 (1921)	30,821
1922–23 .	11,524	13,683	2,739 (1922)	1,166	1,091 (1922)	467 (1922)	30,670
1923–24 .	11,015	13,166	2,529 (1923)	1,111	1,036 (1923)	419	29,276
1924–25 .	10,639	12,085	1,839	967	1,211	270	27,011

In most cases definite information is not available as to the exact extent of the natural wattle forests in each State of the Commonwealth, or as to the actual area at present under cultivation; the following particulars, however, give some idea of the wattle resources of the Dominion.

New South Wales.—The principal species in this State is the black or green wattle, which flourishes best in the colder districts, chiefly on the southern table-lands. The relatively small quantity of golden wattle is practically confined to parts of the country bordering on South Australia and Victoria.

With a view to the perpetuation of wattle trees for the production of the bark, the State Forest Commission a few years ago withdrew from settlement 37,500 acres of Crown lands in the vicinity of Buckenboura on the coast in the south of the State, where some of the best bark is said to be obtained. The black wattle is widely distributed in this area, and steps were taken in 1919 to set apart portions of the land for retention as a national permanent reserve for the growth and preservation of the trees.

In addition to the natural forests there are many small wattle plantations in various districts where bark is produced for local tanneries. In 1924 a company was stated to have been formed and to have established a factory, near Merimbula, installed with modern machinery capable of a daily output of three tons of wattle bark extract.

There is a small export of tanning bark from New South Wales, ranging from 10,691 cwts. in 1920–21 to 614 cwts. in 1924–25, most of which is sent to New Zealand. The imports of wattle bark from South Africa, however, are greatly in excess of these figures, the maximum quantity in recent years being 48,587 cwts. in 1923–24.

Victoria.—The principal districts from which naturally grown wattle bark is obtained are the Dartmoor district on the Lower Glenely, the Avenel, Seymour and Tallarook districts, the Briagolong and Glenmaggie districts in North Gippsland, and the Cunningham and Mitchell River districts in East Gippsland. The best bark is grown towards the west of Victoria, and it becomes less valuable

near Gippsland. The Forest Department in 1913 had about 20,000 acres of natural wattle reserves, consisting chiefly of black wattle, mainly in the Victoria Valley and the Grampians, and also plantations made by the Department to the extent of about 5,000 acres of golden wattle. The chief Government plantations appear to have been at You Yangs, Havelock, Majorca and Kentbruck. There are also several privately-owned plantations in different parts of the State. The best-known plantation is that at You Yangs about thirty-five miles from Melbourne. This has been for some years the largest in Australia, and was established in 1887.

Owing to the extension of cultivated and grazing land, the supply of bark in Victoria has for some years been unable to keep pace with the demand, and recourse has to be made to South African bark.

It is understood that the Commonwealth Government have recently installed plant at the Government experimental station at Melbourne for the manufacture of wattle extract.

Queensland.—The black wattle is said to thrive in this State on the southern coast lands, on ranges inland and also on the vast western wooded plains. Formerly a fair amount of bark was harvested every year from the neighbourhood of Dalveen and from other districts, but attempts hitherto made to grow wattles on a commercial scale in Queensland for the sake of the bark have not met with success. It is considered that the areas at present most suitable for the cultivation of *A. decurrens* var. *mollis* are situated in the country between Warwick and the New South Wales border, and westward for 100 miles, and that some of the poorer country about Crow's Nest now used for grazing would prove suitable.

The following table shows the imports of wattle bark into Queensland from South Africa during the last three years for which official figures are available.

Imports of Wattle Bark into Queensland from South Africa.

	Cwts	£
1922	941	615
1923	nil	—
1924	2,919	1,343

South Australia.—The wattle-growing area in 1924 was estimated by the Conservator of Forests to be over 135,000 acres, comprising an area of about 125,000 acres of golden wattle situated in the Mount Lofty Ranges, 10,000 acres of black wattle in the south-eastern part of the State, and smaller wattle areas in the Flinders Range. For some years there has been more or less systematic planting of golden wattle in the Adelaide Hills, where the trees are stated to reach their maximum value in about 7 to 9 years when they yield from about 5 to 6 tons of bark per acre.

The following statistics collected by the State Advisory Council of Science and Industry in 1924 show the amounts of wattle bark produced in South Australia during the last few years, and also their distribution :

Year.	Quantity	Amount used in South Australian Tanneries	Quantity exported to New Zealand	Balance available for shipment	Total value	Value per ton
	Tons	*Tons*	*Tons*	*Tons*	£	£ s d
1916–17 .	4,713	1,513	nil	3,190	—	—
1917–18 .	4,223	1,437	252	2,534	—	—
1918–19 .	4,959	1,399	nil	3,560	—	—
1919–20 .	6,807	1,294	203	5,310	—	—
1920–21 .	6,595	1,464	614	4,512	72,740	11 0 7
1921–22 .	6,278	1,367	291	4,620	64,950	10 6 11
1922–23 .	5,645	1,166	84	4,385	59,273	10 10 0

Although *A. pycnantha* bark is one of the best tanning materials in the world, the industry makes no headway owing to the importation into Australia of South African wattle bark, practically the whole of which goes to Melbourne and Sydney, where it enters into keen competition with the South Australian product. It is stated that, even with the aid of the import duty of £3 per ton, the South Australian bark cannot be landed in Sydney as cheaply as the South African product.

Experiments have been carried out on the production of liquid extract from the "tops" of the golden wattle, consisting of the small branches, twigs and leaves, of which it is estimated there are 4 tons for every ton of air-dried bark. Such material has been found to contain about 17 per cent. of tannin on the moisture-free material. Two samples of such liquid extract made in the State contained 27·6 and 19·2 per cent. of tannin respectively.

Western Australia.—*A. decurrens* var. *mollis* and *A pycnantha* have been introduced to a limited extent into Western Australia. Experimental plantations have been made from time to time by the Woods and Forest Department with a view to encouraging settlers to plant portions of their holdings which are unsuitable for other crops. In 1922 *A. pycnantha* was sown by the Department in certain areas, amounting to 135 acres, on ground which appeared to be unsuitable for mallet. *A. pycnantha* has been found to develop rapidly on the better soils of the coastal plains, and on ironstone gravel in the Darling Ranges. At Balingup and in other districts there appear to be some very successful plantations, and the Forest Department are considering steps for the development of a systematic cultivation of wattles.

Tasmania.—The vast natural forests of black wattle in the island formerly provided the greater part of the wattle bark for export from the Commonwealth. In consequence, however, of the ruthless destruction of the trees for the bark, and the devastations caused by bush fires and grazing, the black wattle appears to have become nearly extirpated in much of the accessible wattle areas of Tasmania. Hence although Tasmania exported large quantities of wattle bark fifty years ago, in 1912 only about 700 tons were exported from a total estimated production of about 2,897 tons, valued at £25,000. It was estimated in 1914 that there were still about a million acres of black and silver wattle in the State, mostly on privately owned land. The exports of wattle bark are not recorded separately in the official returns, but the following table shows the exports of "tanning bark" from Tasmania during some recent years. These figures presumably represent mostly wattle bark.

Exports of Tanning Bark from Tasmania

Year.	Quantity.		Value	
	Oversea.	Interstate.	Oversea.	Interstate
	Cwts.	*Cwts.*	£	£
1921–22 . .	2,720	—	1,697	—
1922–23 . .	3,241	49,981	1,916	23,558
1924–25 . .	2,823	46,551	1,475	24,086

It is stated that wattle trees in Tasmania are not properly ready for stripping until they are seven years old, though they are usually stripped when about five years old. No cultivation of wattle appears to have taken place in Tasmania.

Kenya Colony and Protectorate.—The experimental cultivation of the black wattle, *A. decurrens* var. *mollis*, was undertaken in British East Africa (now Kenya Colony and Protectorate) about 1903. It was desired to employ the timber as fuel for the Uganda railway and steamboats, but it is understood that the wood was not found satisfactory for this purpose on account of its rapid burning properties.

Consideration was also given to the commercial possibilities of the bark for tanning, and a sample examined in 1908 was found to contain 43 per cent. of tannin. Several other samples which were forwarded to the Imperial Institute in 1910 for examination also proved to be of excellent quality, and showed that the bark would find a ready market in Europe (this BULLETIN, 1910, **8**, 249).

The encouraging results thus obtained led to a rapid extension of the area devoted to wattle. Early in 1911 nearly 3,000 acres were under cultivation, many of the trees being three years old and over, and by 1913 it was estimated that from 7,000 to 7,500 acres had been planted. In 1912, for the protection and regulation of the industry, "The Wattle Bark Industry Ordinance" was enacted, a summary of which was given in this BULLETIN (1912, **10**, 479). The present wattle-growing districts, situated in the Highlands of Kenya, are shown in the following table, together with the number of acres under wattle in each district in June 1925. Future statistics will probably show a reduction in the area under cultivation, for the Director of Agriculture in his Report for the year 1925 states that there is no evidence that planting for replacement is taking place on a scale sufficient even to maintain the present output.

Total Acreage and Actual Production of Dried Wattle Bark during the Twelve Months ending June 30, 1925, in the Colony and Protectorate of Kenya

—	Total area on June 30, 1925 (not stripped of bark)	Area.		Actual production of dried bark between July 1, 1924 and June 30, 1925.
		Under 6 years of age.	Over 6 years of age.	
Kikuyu Province :	*Acres.*	*Acres.*	*Acres.*	*Cwts.*
Embu and Meru	1	0	1	0
Fort Hall	213	197	16	0
Kiambu	4,142	1,064	3,078	53,660
Total	4,356	1,261	3,095	53,660
Nyanza Province :				
Kavirondo North	4	1	3	0
Kavirondo South	2	2	0	0
Kericho	9	6	3	0
Total	15	9	6	0
Ukamba Province :				
Kitui and Machakos	44	13	31	0
Nairobi	250	130	120	0
Total	294	143	151	0
Extra Provincial Districts :				
Kisumu-Londiani	91	1	90	500
Naivasha	5	0	5	0
Nakuru	1,905	41	1,864	8 180
Nyeri	27	19	8	0
Trans Nzoia	368	329	39	0
Uasin Gishu	1,769	1,000	769	0
Total	4,165	1,390	2,775	8,680
Grand Total	8,830	2,803	6,027	62,340

The following table shows the exports of wattle bark from Kenya from the year 1910–11, when the first 10 tons were exported, to 1926. During the war the export of bark practically ceased, owing to the lack of shipping and other circumstances. In the years following the cessation of hostilities the industry was faced with the difficulty of high freights, and only in recent years has the export been again remunerative. The diminution in the exports of bark since 1924 is due to a great extent to the employment of the bark in Kenya for the production of extract.

Exports of Wattle Bark from Kenya Colony and Protectorate

Year.	United Kingdom. Cwts.	Germany. Cwts.	Total. Cwts.	Value. £
1910–11	200	—	200	47
1911–12	—	860	860	333
1912–13	640	400	1,040	508
1913–14	1,600	2,420	4,040 (*a*)	1,917
1914–15	—	540	540	237
1915–16	—	—	—	—
1916–17	—	—	—	—
1917–18	(*b*)	—	(*b*)	10
1918–19	124	—	124	32
1920	(*b*)	(*b*)	9,025	6,780
1921	—	—	—	—
1922	580	(*b*)	9,414	2,708
1923	6,360	(*b*)	17,794	5,836
1924	3,038	(*b*)	71,416	17,901
1925	27,384	(*b*)	62,817	19,669
1926	(*b*)	(*b*)	36,537	13,702

(*a*) *20 cwts. to France.* (*b*) *Information not available.*

The increasing demand for wattle extract and the desire to obtain a more remunerative industry led to the establishment in 1923 of an extract factory in Kenya, and the following amounts of extract have since been exported:

	Cwts.	£
1925	9,203	5,163
1926	12,396	11,156

The cultural conditions for wattle in Kenya have proved more favourable than in Natal, the trees reaching maturity at an earlier age and furnishing from 5 to 6 tons of bark per acre as compared with about 4 tons in Natal. Under the best conditions, the first stripping of the bark can be effected either in the fourth to the fifth year, or else in the fifth to the sixth year, when the trees should be 6 to 8 in. in diameter and 90 ft. high. In Natal, on the other hand, the trees must attain an age of seven or eight years before the bark is sufficiently matured to give the best results; they then have an average diameter of only about 5 to 6 in. Moreover, Kenya wattle bark contains a higher average percentage of tannin than Natal bark. The examination of a large number of samples of Kenya wattle bark at the Imperial Institute showed an average tannin content of 37 per cent. On the other hand, Kenya is at a disadvantage as compared with

Natal in not having a ready local market for the wood. The industry too is not so highly organised ; some of the bark is badly harvested, and this inferior bark tends to keep the price of the Kenya produce below that of Natal bark.

Tanganyika.—During the German occupation the black wattle was cultivated successfully from seed obtained both from Natal and Australia, and as early as 1904 plantations laid down principally in the neighbourhood of West Usambara furnished bark of satisfactory quality. Two small consignments, each of about one ton, sent to Hamburg in 1909 contained 40 and 33 per cent. of tannin respectively. Plantations of *A. decurrens* vars. *mollis* and *normalis* were also made at Wilhelmstal, and several samples of bark, taken from trees of each variety, gave an average of 44 per cent. of tannin for var. *mollis* and 38 per cent. for var. *normalis*. In 1925 the Forest Department decided to raise seedlings and plant up a new wattle plantation at Amani to replace the existing plantation which appeared to have suffered through neglect.

India.—In addition to about eighteen species of indigenous acacias, India possesses also the Australian species, *A. decurrens* var. *mollis* (black wattle), and *A. dealbata* (silver wattle), which were introduced on the Nilghiri Hills in the early forties of the last century and have become established. At altitudes above 7,000 ft. only the black wattle, which is by far the less plentiful of the two, is found, whilst at the lower elevations the silver wattle occurs in increasing numbers. These two species appear to have been introduced mainly with the object of providing fuel, of which there was a shortage at that time, and although the bark appears to have been employed locally to some extent for tanning, it is only within recent years that the valuable tanning properties of the black wattle bark have been realised by planters, and that any serious attempt has been made to cultivate the tree. A report received from the Director of Agriculture in Madras in 1925 stated that the Forest Department had during the last few years been planting black

wattle round the pine plantations at Kodaikanal as a fire belt, but that no large-scale cultivation had been undertaken by the Government. Several small privately owned plantations now exist, but the supply of bark is small and insufficient for the local demand, and considerable quantities of wattle bark are therefore imported from Natal. The South African product appears to have first been employed in India in 1915; the quantities subsequently consumed, according to the Indian official returns, are shown in the following table:

Indian Imports of Natal Bark

	Cwts		Cwts.
1915–16	25,952	1921–22	23,603
1916–17	35,433	1922–23	9,440
1917–18	55,366	1923–24	11,685
1918–19	20,731	1924–25	21,392
1919–20	57,738	1925–26	96,077
1920–21	41,934		

Samples of bark from plantations in Madras and Travancore were examined at the Imperial Institute in 1925 with the following results:

		Madras.		Travancore
	Per cent	*Per cent*	*Per cent*	*Per cent*
Moisture	10·8	10·4	9·4	9·2
Insoluble matter	32·4	44·3	42·2	45·4
Extractive matter (non-tannin)	10·0	9·9	10·2	8·3
Tannin	46·8	35·4	38·2	37·1
Ash	2·3	2·4	2·0	2·5
Tintometer readings:				
Red	5·2	4·1	3·1	4·3
Yellow	5·0	6·2	4·2	5·4

The bark is thus of good quality and compares very well with the South African product. In view of the local demand there is every prospect that the wattle plantations in Southern India will be extended, but consignments for export will not be available until the production has considerably increased. The question of freight will then be an important factor in competition with Natal bark.

As a result of enquiries specially made by the Imperial Institute, it appears that the wattle tree does not occur in Burma, and it is doubtful whether the soil and climate

are suitable for its growth. It would be difficult to arrange either the skilled supervision necessary for the introduction of a new tree, or the supply of cheap and efficient labour which would be required. It therefore appears unlikely that wattle cultivation could be successfully undertaken in Burma.

Ceylon.—The black wattle, *A. decurrens* var. *mollis*, was introduced into Ceylon over thirty-five years ago, and cultivated in the Hakgala Botanic Gardens. Trees are now found scattered over the tea estates, and are also grown in blocks for firewood. The tree thrives in suitable situations, and provides bark of good quality, which is used in local tanneries.

In connection with enquiries made by the Imperial Institute in several parts of the Empire a few years ago with a view to the extension of wattle cultivation, samples of bark from trees growing in the Hakgala gardens were received for examination in 1923. The samples contained 27·5 to 33·6 per cent. of tannin and produced leather with the usual characteristics of wattle-tanned leather (this BULLETIN, 1923, **21**, 466). A trial consignment of 11½ tons of bark was shipped to the United Kingdom in 1924. The material realised the current market price of wattle bark, but the profit on the entire consignment was only £5 13*s*. 5*d*., owing to the heavy railway charges and ocean freight which together amounted to over £5 per ton, or about twice as much as the corresponding charges on bark from South Africa at that time. Hence, although wattle bark of good quality can be produced in Ceylon, the transport charges are at present too high to make the export of the bark remunerative.

Nyasaland.—It is understood that the cultivation of black wattle has been attempted in Nyasaland, but without success, owing to the lack of moisture for many months of the year. There are areas where wattle might succeed, but these are very limited, and it does not appear worth attention as an economic crop. Further, railway and ocean freights from Nyasaland to the United Kingdom are too high to allow bark produced in Nyasaland to compete with Natal bark.

Seychelles.—A sample of bark from trees grown in Seychelles has been examined at the Imperial Institute. It was paler in colour and of rather different appearance from the black wattle bark of Natal and East Africa, and was found to contain only 12 per cent. of tannin. Such bark would not be suitable for the British market. It was suggested that if other varieties of wattle occur in the Seychelles, samples of the bark should be forwarded to ascertain if any of them are of commercial interest, but no further samples have yet been received.

West Indies.—The Commissioner of Agriculture for the West Indies has informed the Imperial Institute that the possibility of wattle cultivation in the West Indies had received some attention, but the prospects did not appear to be attractive.

Mangrove Bark

The name "mangrove" is applied to a number of trees, most of which belong to the Natural Order *Rhizophoraceæ*. These trees or shrubs inhabit the muddy swamps close to the seashore, and at the mouths of the rivers in tropical countries, where they frequently form forests of vast extent. Mangroves are noted for their abundance, wide distribution and rapid growth. They are found distributed widely throughout the tropics, viz. in India, Indo-China, Federated Malay States, Philippine Islands, Borneo; West and East Africa; Madagascar; Australia, Papua and New Caledonia; on the southern coasts of the United States of America; in Central America, and on the northern shores of South America.

All parts of the trees contain tannin, but it is only the bark that, from a commercial standpoint, contains sufficient of this constituent. The mangroves best known as yielding bark suitable for tanning purposes are: *Rhizophora mucronata* Lam., and *R. Mangle* Linn.; *Bruguiera gymnorrhiza* Lam.; *Ceriops Candolleana* Arn., and *C. Roxburghiana* Arn.; *Kandelia Rheedii* Wight and Arn. Other forms of mangrove include *Carapa moluccensis* Lam. (= *Xylocarpus granatum* Koen.); *Ceriops Tagal* Robinson;

Rhizophora conjugata Linn.; *Bruguiera eriopetala* Wight and Arn. and *B. parviflora* Wight and Arn., and *B. Rheedii* Blume; *Heritiera* spp.; and *Avicennia officinalis* Linn.

It has been frequently proved that the percentage of tannin in the bark of the same variety of mangrove is not constant, but varies according to the locality in which the tree grows. This variation is illustrated by the following results recorded for the bark of *Rhizophora mucronata*:

Country of Origin.	Tannin. *Per cent.*
Malaya	30 to 40
Tanganyika Territory	36·5
India, Sunderbans	35·0
South America	30·0
Philippine Islands	27·6
Borneo	20·5

It will therefore be seen that it is impossible to state for each variety a definite figure for the percentage of tannin generally present in its bark.

Although, as has been shown from investigations carried out on barks from Tanganyika Territory, the percentage of tannin in the bark does not vary according to the age of the tree or the season of the year in which it was stripped, yet with some varieties, e.g. *Rhizophora mucronata* and *Bruguiera gymnorrhiza*, it is recommended that the material should be collected at the end of the year, as the leather yielded by such bark is of lighter colour and not so red as that prepared from material stripped at other times. This feature is of importance because mangrove bark has the disadvantage of imparting to leather a dark red colour. On this account its general use has been somewhat retarded. Apart from this defect, mangrove-tanned leather, when properly made, is of fair quality and suitable for shoe leather and for similar purposes.

The use of mangrove bark in British tanneries is of comparatively recent date. Prior to 1914 exports seem to have been sent principally to Germany, the United States and Russia, while only small quantities were imported into the United Kingdom. Since the war, however, the use of this tanning material has been on the increase in this country. It has been found that, when used in admixture

with other materials, it can be successfully employed, and it is therefore usually blended with pine, oak or wattle.

Mangrove bark intended for export should contain at least 30 per cent. of tannin, and in this connection it is interesting to note that, when Tanganyika Territory formed part of the German Empire, no mangrove bark was allowed to be exported containing less than 45 per cent. of tannin. In many countries, however, the mangrove bark does not contain as much as 30 per cent. of tannin, and, in this case, if it is desired to create an overseas trade in the material, the bark has to be converted into an extract or "cutch," the preparation being carried out according to the usual method employed for the manufacture of tanning extracts. It should be emphasised that before concentration the aqueous extract should be decolourised to give a high-grade product. Decolourisation, however, is not so readily effected in the case of mangrove bark as with other extracts. Nascent hydrogen is stated to be the most successful bleaching agent. The addition of alum, or barium aluminate and a sulphate, also gives good results, but these reagents entail a certain loss of tannin.

Bark intended for export should, after being stripped from the living or dead trees, be dried as soon as possible, care being taken that it is not unnecessarily exposed to rain, as this incurs a loss of tannin. The drying is effected either in the sun or by artificial heat. The dried bark is baled for export, in some cases under pressure. Occasionally the bark is roughly ground before being bagged for export.

As far as the British Empire is concerned, varieties of mangroves occur abundantly in a considerable number of countries, notably in British East Africa, British North Borneo, India, Australia, British West Africa and the Federated Malay States.

British East Africa.—Mangrove bark from Tanganyika Territory and Kenya represents, on the whole, the richest in tannin of any obtained within the Empire. That found in the former country has been exploited for a considerable number of years, and a large trade was

carried on by the Germans prior to 1914. Apparently, however, the trade dwindled to very small dimensions, for in 1923 only 7½ tons were exported. In the following year the exports had increased to 247 tons, while in 1925 3,077 tons were shipped, most of which went to Germany.

The different varieties of mangroves found in Tanganyika Territory were investigated nearly thirty years ago. The chief varieties occurring there are *Rhizophora mucronata*, containing up to 48 per cent. of tannin; *Bruguiera gymnorrhiza*, with from 28 to 53 per cent.; *Ceriops Candolleana*, with 24 to 42 per cent., and *Carapa moluccensis*, with 27 to 40 per cent. Concessions are granted in this country as in others for the exploitation of the mangrove forests.

The following table shows the exports from Kenya and Uganda:

Year.	Quantity. Tons.	Year.	Quantity. Tons.
1913–14	8,062	1917–18	308
1914–15	3,049	1918–19	150
1915–16	3,012	1919–20	900
1916–17	737	1920–21	25
		1926	261

During the years 1922-25 the exports of mangrove bark were not recorded separately.

In Zanzibar and Pemba mangrove trees are abundant in the creeks, and especially throughout Pemba. Samples of the barks have been examined at the Imperial Institute and gave the following results (this BULLETIN, 1904, **2**, 163):

	Tannin. *Per cent.*
Zanzibar	35·8
Pemba	23 to 34

It will be noted that these samples are not quite so rich as those from Tanganyika Territory.

British North Borneo.—Another part of the Empire which exploits the mangrove forests for export is British North Borneo. Whereas in British East Africa the bark itself is shipped, in North Borneo the trade is almost, if not entirely, confined to mangrove "cutch," as the bark

is not sufficiently rich in tannin to render its export profitable.

The mangrove forests occupy large areas in this part of the Island and are mostly found on the east coast. The chief varieties are *Rhizophora conjugata*, *R. mucronata*, *Ceriops Tagal*, *Bruguiera eriopetala* and *B. gymnorrhiza.* The bark from these varieties contains from 25 to 35 per cent. of tannin.

The manufacture of mangrove cutch is a well-organised and old-established industry in the country, and has assumed great importance. With the increased use of mangrove by the tanning industry in the United Kingdom, the exports of the cutch to the home country have grown larger.

Federated Malay States.—Large areas of mangroves exist in the Federated Malay States, there being 250 square miles of mangrove forests on the coast of Perak and Selangor. The chief varieties found are *Rhizophora mucronata*, *R. conjugata*, *Bruguiera gymnorrhiza*, *B. eriopetala* and *Ceriops* sp. All these trees yield bark containing over 25 per cent. of tannin, but they are not so rich in this constituent as are the East African trees.

In 1923 there were exported from British Malaya 11,601 tons of mangrove bark, most of which went to Hong Kong and China.

India.—Abundant supplies of mangrove bark are available in many parts of India. The principal mangrove areas are the Sundarbans, the delta forests of the Irrawaddy, on the Arakan coast, in Mergui and Tavoy, and in South East Madras. Although large quantities of the bark are available, up to the present its use has been confined to local tanneries.

The principal species occurring in India are *Rhizophora conjugata*, *R. mucronata*, *Heritiera Fomes* Buch.-Ham. (= *H. minor* Roxb.), *Ceriops Candolleana*, *C. Roxburghiana*, *Carapa* spp., *Bruguiera* spp. and *Sonneratia* spp.

The forests of the Sundarbans and of South Tenasserim

have been investigated with a view to the exploitation of the bark of the mangrove trees. In the former district the commonest varieties are:

	Tannin. Per cent.
Heritiera Fomes	10
Ceriops Roxburghiana	37
Excœcaria Agallocha Linn.	10
Sonneratia apetala Buch.-Ham.	14

while in South Tenasserim the following are the most abundant varieties:

	Tannin. Per cent.
Rhizophora mucronata	45
R. conjugata	36
Carapa moluccensis	27
Ceriops Candolleana	41
Bruguiera gymnorrhiza	42

As regards the Sundarbans it is recommended that the barks of *Heritiera Fomes* and *Ceriops Roxburghiana* should be utilised commercially for the manufacture of tanning extracts.

Samples of Indian mangrove bark have from time to time been examined at the Imperial Institute, and the analyses have shown them to contain from 4 to 27 per cent. of tannin, a content considerably less than most of those quoted above.

Mangrove bark from India is, on the whole, less rich in tannin and therefore less suitable for export than that from East Africa. Trials have been made to determine the suitability of Indian barks for the preparation of extracts. Samples of such extracts have been examined at the Imperial Institute and shown to be of inferior quality. There can, however, be but little doubt that mangrove extract of good quality can be prepared from several varieties of Indian bark.

For many years the Indian Government maintained an experimental factory for the manufacture of mangrove extract in Rangoon. It was, however, closed down in 1905, as it was not a success. Nevertheless, in spite of this reverse, the best method of developing an export trade in Indian mangrove barks appears to be to manufacture extract for shipment.

Queensland.—As far as Australasia is concerned the mangrove forests that have received the most attention are those of Queensland and Papua. The Queensland bark is stated to contain about 39 per cent. of tannin. The most common mangroves found in the area from Murray River to Point Cooper (4,600 acres) are *Rhizophora mucronata* (27 to 36 per cent. of tannin) and *Bruguiera Rheedii* Blume (13 to 20 per cent. of tannin). These two varieties together represent about half of the mangroves occurring there. Two other varieties are fairly common, viz. *Bruguiera parviflora* (5 to 10 per cent. of tannin) and *Ceriops Candolleana* (21 to 26 per cent. of tannin). A number of concessions have been granted from time to time, but an export trade does not yet appear to have been created. With a view to stimulating the use of the material, a Committee was appointed by the Institute of Science and Industry to investigate the decolourisation of mangrove extracts. They, however, were not successful in reducing the colour of the extract, but did succeed in preparing from Queensland bark a lighter coloured leather.

It appears very doubtful whether by using white labour to strip and handle the bark, Australia can compete with countries where cheap black labour is available and where extracts are now being manufactured. It is not likely that mangrove bark will be used in this continent for tanning leather other than sole leather as long as tanners can get wattle bark and extracts.

Papua.—Abundant supplies of mangrove bark are available in Papua. The chief varieties occurring in this country are *Bruguiera Rheedii, Rhizophora mucronata* and *Carapa moluccensis*, the barks of which contain 31, 18 and 24 per cent. of tannin respectively. Large quantities are stated to have been shipped to Australia in 1917, but efforts to develop a regular industry have so far not proved successful, the cause of the failure being ascribed to a lack of capital or of knowledge.

British West Africa.—Although mangroves abound in West Africa, they have not been exploited to the same extent as in East Africa. Furthermore, the West African

bark is not so rich in tannin as that from the other side of Africa. Samples from Sierra Leone, Gambia and the Gold Coast examined at the Imperial Institute have been found to contain up to 28 per cent. of tannin (this BULLETIN, 1907, **5**, 343 ; 1913, **11**, 415 ; 1921, **19**, 147).

Small shipments of mangrove bark from Sierra Leone, containing 18 per cent. of tannin, were offered on the market some years ago, but, as could only be expected with bark of this low tannin content, they were unsaleable.

Mangrove bark is used locally in West Africa for tanning purposes, but there appears to be no export trade in it.

Other Countries.—Besides the countries already mentioned, mangroves are also found in Seychelles, Fiji, Bahamas, British Honduras and British Guiana.

Aldabra Island is the only island in Seychelles which produces mangroves. Samples of the bark were examined at the Imperial Institute with the following results (this BULLETIN, 1907, **5**, 343) :

	Tannin. Per cent.
Rhizophora mucronata	25 to 35
Bruguiera gymnorrhiza	42 to 45
Ceriops Candolleana	35
Pemphis acidula Forst.	43

Small consignments of the Seychelles bark are reported to have been sold.

From Fiji samples of extract were received and examined at the Imperial Institute (this BULLETIN, 1913, **11**, 418), and contained 60 to 70 per cent. of tannin. These trials showed that good extract could be prepared in Fiji, but that it must be decolourised before concentration.

In the Bahamas *Avicennia nitida* Jacq. is the most common variety.

Samples of *Rhizophora Mangle* bark from British Honduras and British Guiana have also been examined at the Imperial Institute, and found to contain 5 to 20 and 25 per cent. of tannin respectively (this BULLETIN, 1907, **5**, 343).

Conclusions.—The above review of the mangrove forests of the British Empire demonstrates that there are

large supplies of mangrove barks available for commercial exploitation. With the exception of East Africa, British North Borneo and the Federated Malay States, none of the countries appears to engage in the exportation of either the bark or extract.

The most suitable method for exploiting the mangroves in the majority of these countries appears to be to manufacture an extract of good quality for export. For this, as for the bark itself, there appears to be a growing market, as mangrove is calculated to be the cheapest tanning material per unit of tannin, and has also rapid penetrating powers which are conducive to quick tannage.

Mallet Bark

This material, which is one of the world's richest tan barks, is derived from the brown mallet tree, *Eucalyptus occidentalis* Endl., var. *astringens* Maiden. The source of supply is Western Australia, where the tree is known locally as the "flat-topped yate." It occurs over a comparatively narrow strip of country on the west side of the York–Albany railway line, and over a strip, 150 miles in width, on the east side of the line. The tree reaches an average height of 60 to 80 ft., and is covered with a black outer cortical layer which contains only 9 to 14 per cent. of tannin. This outer bark is removed, and the inner bark, bright yellow to dark brown in colour, is sent into commerce in pieces varying from 2 to 12 in. in length. The average composition of mallet bark is as follows:

	Per cent.
Moisture	14·5
Tannin	42·0
Extractive matter (non-tannin)	8·0
Insoluble matter	35·5

The tannin content varies from 31 to as much as 52 per cent., and the non-tannin extractive matter from 5 to 10 per cent. According to Paessler, the sugars present amount to 2·2 per cent., which corresponds to about 5 parts of sugars to 100 parts of tannin. The tannin belongs to the catechol group. It is easily leached with cold water, 90 to 95 per cent. of the tannin being extracted, as compared with 50 to 60 per cent. from quebracho. The use

of warm water increases the amount of tannin extracted from the bark, and the operation can be satisfactorily performed at 60° C. The liquor so obtained is strong and clear, and no deposit collects on cooling or long standing. Mallet bark has been found to be an excellent tanning agent. Calf skins tanned with it produce leather of normal quality throughout, the colour being light and regular. The leather possesses a fine, uniform grain, a smooth, fleshy side, and is very tough. The leather produced by the sole use of mallet bark has an orange tint, but this can be obviated by using other tanning materials in conjunction with it. An unsatisfactory feature of mallet bark tannage is the tendency of the leather to darken on exposure to light and to assume a reddish tint. The bark is also successfully used for tanning hides. In consequence of the low content of non-tannin extractive matter, only a small amount of acid is formed in mallet bark liquors by fermentation, and, in order to induce swelling, other tanning agents rich in sugary matter must be included in the tannage or the deficiency overcome by the addition of lactic or acetic acid.

The mallet bark industry of Western Australia has suffered through excessive exploitation. Prior to 1903 the value of the bark had not been fully recognised, but apparently in that year its commercial possibilities were discovered and the rapid development of the export trade commenced, to which reference has already been made in this BULLETIN (1905, **3**, 69; 1908, **6**, 318; 1911, **9**, 179). The qualities of the bark were quickly appreciated in Germany, and a large demand arose. In 1904 about 3,000 tons were exported, of which 2,600 went to Germany, and in 1905 the exports had risen to 16,000 tons, of which Germany received 15,000 tons. The value of the exports in 1905 amounted to £154,047, but from this year onwards the quantities of bark exported steadily decreased. The value of the exports in 1913 was £47,777, and in 1918 £16,886. The cause of the decline was the indiscriminate destruction of the mallet forests, which took place when the value of the bark became known. The Western Australian Government drew up regulations restricting the cutting of the trees, but not before great damage had

been done, and it would appear that the regulations were not strictly enforced. From 1918 to 1925 the shipments of bark remained on an average about equal to those of 1918, Germany being the chief customer. The depletion of the resources has affected not only Europe, but the tanneries of the eastern states in Australia, where anxiety is being felt regarding the maintenance of supplies. In recent years mallet has been so scarce in its original habitat that exporters of bark have obtained their material from young saplings, which have been stripped standing. To prevent the continuance of this dangerous practice, and the extinction of the species which would eventually follow, the Forests Department have recently taken steps to enforce the existing regulations, and it is hoped that the regeneration of the mallet forests will be achieved in due course. A preliminary survey has disclosed the existence of considerable areas of dense re-growth on poor rocky hill-tops. The protection and extension of these areas of new growth on land that is unsuitable for other purposes is likely to prove a profitable undertaking to the State; certain reserves have already been created and silvicultural work commenced.

The commercial mallet bark as exported from Western Australia has frequently been a mixture of the bark of the brown mallet with the barks of the following mallets, which are of less value.

White Mallet (*Eucalyptus faloata* Turcz. var. *ecostata* Maiden). The air-dry bark contains about 30 per cent. of tannin. The tree occurs scattered in mallet patches.

Blue Mallet (*E. Gardneri* Maiden). The tree occurs in close formation on patches of limited extent. The average tannin content of the air-dry bark is 26 per cent.

Swamp Mallet (*E. spathulata* Hook.). This tree occurs in scattered patches in the south-west corner of the savannah forests, and its bark in air-dry condition contains about 26 per cent. of tannin.

In 1905, when the export of mallet bark to Europe was at its height, the threat to the trade in wattle bark was realised in South Africa, and the cultivation of the mallet tree in that country, especially in the south-west district of Cape Province, was considered. As it was

apparent, however, that the exports of mallet bark from Australia could not be maintained on a scale at all approaching that of 1905, the anxiety passed and no steps of any importance were taken. At the same time Germany anticipated a diminution of supplies, and the introduction of the tree into German colonies was contemplated, but there is no evidence that such a scheme was carried into effect.

Hemlock Bark

This tanning material, derived from the hemlock spruce tree, is of great importance in Canada and in the United States, and is imported into the United Kingdom from the former country. There are three species of hemlock in the Canadian forests, two of which are of interest in the present connection. These are (1) the Eastern hemlock, *Tsuga canadensis* Carr., and (2) the Western hemlock, *Tsuga heterophylla* Carr. The former is found from Nova Scotia westward throughout the St. Lawrence river valley and Ontario to the west end of Lake Superior, but does not occur west of this district, while the latter is practically confined to British Columbia. It is the eastern hemlock which has played so great a part in the tanning industries of Canada and the United States, the utilisation of the western hemlock being still in its infancy. Eastern hemlock at one time was felled only for the purpose of stripping the bark, and the logs were left to burn or rot in the forests. To-day hemlock wood is more valuable than the bark, and occupies fourth place as a lumber producer in Canada, with an average annual cut of about 250 million feet board measure. The eastern hemlock forms approximately 85 per cent. of this lumber, and the remainder is cut mostly from the western hemlock. This figure gives indirectly an indication of the abundant resources of hemlock bark in Eastern Canada. Eastern hemlock bark contains from 8 to 10 per cent. of tannin, which belongs to the catechol group, and the material is generally employed in the form of extract. For this purpose the trees are cut down and the bark immediately stripped off. The bark is then allowed to lie with the inner side uppermost until comparatively

dry, when it is piled ready for removal to the factories. It forms one of the principal tanning materials used in Canada, not only for the red hemlock sole leather, but in combination with other tans or alum for a large proportion of the exported dressing leather. An extract of the bark is exported, but the quantities have decreased during the last few years. The United Kingdom has been the chief consumer of the exported extract, but of late years the imports have decreased, and during the last three years hemlock extract has not been used in this country to any large extent. The decline is attributable to the preference British tanners show for other materials, when the latter are obtainable at a satisfactory price.

Hemlock Extract

Value in $ of Exports from Canada.

Years ending March 31.

	1921.	1922.	1923.	1924.	1925.	1926.	1927.
United Kingdom .	31,300	28,868	19,623	1,580	—	—	—
Newfoundland .	2,455	2,967	1,971	1,300	736	2,457	1,342
United States .	202	15,109	4,578	30	84	—	—
Other countries .	—	—	—	—	393	—	—
Total .	33,957	46,944	26,172	2,910	1,213	2,457	1,342

The bark of western hemlock contains 10 to 12 per cent. of tannin. The quantities of this bark available in British Columbia are very extensive, but are mostly wasted owing to the methods of lumbering. In Eastern Canada there is a steady demand for hemlock bark, and its production is an important adjunct to the lumber industry, the peeling of the logs in the forest forming a remunerative operation. In British Columbia, however, the hemlock logs with bark attached are floated to the mills for the production of timber, where the bark is discarded. A small amount, sufficient for the requirements of the tanneries of the Pacific coast, is utilised, but the export of the bark is prohibited by the cost of transport. In the United States the western hemlock is found along the coast ranges through Washington and Oregon to Northern California, and is stated to be used in several western tanneries.

Avaram Bark

Avaram bark, also known as Turwad, Avla and Tanners' Cassia, is the most important tan-bark of India. It is obtained from *Cassia auriculata* Linn., a bush which grows wild in the south and west of India, covering large areas in the Deccan. It is also found in the dry zone of Upper Burma. The right of collecting the bark from Government forests in India has for years been granted on contract by the Forest Department, and the contracts are usually put up to auction. The bark is, however, much more plentiful outside reserve forests, occurring on most village lands. The method of collection consists in cutting off at the base branches and twigs which spring from the root. The coppiced bush sends out a large number of shoots, and a new harvest can be taken after a year. The stripped bark dries in small cornets, and the product usually delivered to the tanneries contains on an average about 18 per cent. of tannin and 10 per cent. of soluble non-tans. Analyses conducted at the Imperial Institute and elsewhere have shown that the bark from old plants may contain as much as 23 per cent. of tannin, while that from young plants may contain only 12 per cent. or even less. The soluble non-tannin matter may be as high as 14 per cent.

The use of the bark is confined to Southern India, where in the past it has been the principal tanning material used in the preparation of East India tanned hides and of tanned goat and sheep skins. The greater part of the collected bark is consumed in Madras, where the production of tanned hides and skins for export is chiefly located. The amount of bark collected in Madras provides only a part of the local requirements, two-thirds of the total quantity employed being obtained from Mysore and Hyderabad.

The success of the tanning industry in Madras is regarded as almost entirely due to the peculiar qualities of avaram bark and to the fact that supplies in the past have been available at a low price. It produces a special form of leather, lightly tanned, with an elastic grain, of a pale colour and with good tensile strength. This half-tanned leather, known as East Indian tanned hides, is

exported to the United Kingdom, where its tannage and preparation for a variety of uses is completed. The special feature of avaram bark is that it is very easy to use, and in spite of the carelessness which often obtains in its application by native tanners, it yields uniformly successful results. During the war the enormous demand for the bark, consequent upon the increased output of South Indian tanneries, caused many areas to be stripped in such a way that the supply was seriously affected, and great anxiety was manifested as to the renewal of regular supplies. In 1918 the consumption in the tanneries making war leather was estimated at 80,000 maunds per month. The average price paid for avaram bark before the war was Rs. 3 per maund; during the war the price ranged from Rs. 5 to Rs. 15. The importance of establishing plantations of avaram was recognised, and experiments were carried out on its cultivation in the Bombay Presidency (including Sind), the United Provinces, Madras and Burma from 1916 to 1921. In the United Provinces and in Sind the climate proved to be unsuitable. In Madras the experimental raising of seedlings, which had proved troublesome in the earlier attempts at cultivation, was brought to a successful issue, but the cultivation was nowhere taken up to any extent. The cost of agricultural land and of labour is high, and it has not yet been shown that the cultivation of avaram would be a commercial success. With regard to departmental experiments, it would appear that about 1921, when a comparative falling-off in the demand for avaram had taken place owing to the termination of the market for war materials and to the large stocks of leather on hand, it was not thought advisable to incur further expenditure and the matter was allowed to lapse.

At the present time it is considered that the wild avaram bark available for collection is sufficient to meet the requirements of the industry. The cost of labour, however, has increased to such an extent that the price of avaram bark has consistently risen, reaching as much as Rs. 45 per maund in 1926. The price obtained for the tanned hides does not permit of the employment of avaram at its present high cost as the principal tanning agent.

Other tanning materials have been largely substituted, but these have so far failed to produce such satisfactory effects as the avaram bark to which the Madras tanner has for so long been accustomed.

Babul

The bark of the tree *Acacia arabica* Willd., known as babul bark, constitutes the most important tanning material of Northern India. The tree is indigenous to Sind, Rajputana, Berar and the Central Provinces, Gujerat, and the Northern Deccan, but it is also cultivated and grown throughout the drier parts of India, and to a small extent in Upper Burma. The babul forests are situated in Bombay (including Sind), Berar (Central Provinces) and Madras. The largest forests are found in Sind, in the Hyderabad and Jerruck Divisions of which province they cover 170,000 acres. In many parts of India the babul occurs only in the form of small patches of isolated trees.

The bark is largely used in small village tanneries throughout Northern India, and is the principal material used in the leather industry of Cawnpore. In 1919 it was stated that over 500,000 maunds of bark were being consumed in the great tanneries of that city. The bark supplies in the immediate neighbourhood of Cawnpore have been practically worked out, but abundant quantities are available within easy reach, and the cost of the bark remains relatively low as compared with that of avaram bark in Madras. The tannin present in the bark varies considerably and may attain to 20 per cent., but the average content of the bark delivered to the tanneries is about 12 per cent., while the soluble non-tans amount to about 8 per cent. The leather made from babul bark possesses firmness and durability in a high degree, but exhibits harshness and is dark-coloured. The Cawnpore industry produces a finished leather for home use in the tannage of which myrobalans also enter. Babul bark is not suitable for the production of half-tanned hides such as are produced in Madras by means of avaram bark. Leather produced by the former bark does not lend itself readily to re-tanning to meet the various requirements of the United Kingdom market, and consequently Cawnpore,

though situated in the centre of the best hide-producing area in India, does not participate in the export trade of half-tans. Avaram bark is not obtainable in the districts around Cawnpore, and the railway freight does not permit of its profitable use in that city. The tanning industry of Northern India relies on the supply of babul bark in the same way as the Madras industry depends on the occurrence of avaram bark.

The bark of *Acacia arabica* is not of importance as a tanning material outside India, where its abundance makes it a cheap and readily procurable tan. It is not sufficiently rich in tannin or attractive in its properties to be considered for the world market.

NOTES

Tobacco-Growing in British Columbia.—The following despatch, dated May 13, 1927, has been received by the Department of Overseas Trade from H.M. Trade Commissioner at Vancouver.

The success which attended efforts to grow tobacco in the province of British Columbia during the summer of 1926 and to find a market for the leaf in Great Britain was such that during the winter months plans have been laid for production on a much increased scale in the present season. The cultivation of tobacco in British Columbia has been confined hitherto to the southern portion of the Okanagan and Similkameen Valleys, but this year will be more widespread, embracing the Vernon and Kamloops districts, the Fraser Valley and Vancouver Island.

According to the Secretary of the Okanagan Tobacco Growers' Association, tobacco will be grown this year on some 250 acres in the Kelowna district, on 90 acres at Oliver, and on approximately 40 acres at Vernon. A new Association, comprising farmers who are contracting to grow tobacco, has recently been formed and is known as the British Columbia Tobacco Growers' Association.

One of the principal companies responsible for the production of tobacco in the Province has contracted for more than 1,500 acres in various parts of the Province for the present year.

It is maintained by a British Columbia packer of tobacco that various types of tobacco can be grown in the Province

which are at least equal to leaf produced elsewhere on the North American continent. The types of tobacco grown in Canada for the British market consist mostly of flue-cured tobacco which is used for both cigarettes and for pipe-smoking, and it is claimed that the types as well as the texture and colour of the tobacco grown in British Columbia can equal anything produced in the United States.

There are various localities in the Province which can produce an excellent type of Virginia seed for which there is a world's market. With the preference accorded to Empire-grown tobacco on importation into Great Britain, and with the facility of inexpensive transportation by the Panama route, growers of tobacco in this Province anticipate being in a favourable position to compete in the London market. The large number of enquiries received from Europe indicates that there is a ready market for British Columbia tobacco. The intention of local packers is to put up the Virginia types of White Burley tobacco in hogsheads, grading similarly to the practice in the tobacco-producing areas of the United States. As, apart from favourable considerations already mentioned, much of the soil in British Columbia consists of a volcanic ash and climatic conditions are suitable, the prospects of successful competition with existing sources of supply are considered to be encouraging, and hopes are entertained that the tobacco-growing industry will become an important source of wealth to the Province.

South American Wools.—An interesting article on "South American Wools," by H. Kenningham, has appeared in the *Journ. Text. Inst.* (1927, **18**, T81). It is pointed out that South America possesses geographical and climatic conditions which are favourable to the production of high-class wools and that, although the present output is considerably lower than that of twenty years ago, the various governments are fully alive to the possibilities of extension in view of the increased demand due to an ever-widening consumption.

Argentine Republic.—In the Argentine Republic the sheep usually graze (together with cattle and horses) in fenced fields of from 100 to 5,000 acres. It is recorded that the first Merino sheep was introduced into the country in 1794, the first Southdown sheep in 1824, and the first Southdown ram in 1844. Little is known of the ancestry of the early native sheep. The types of wool at present grown are (in order of the annual production): (1) Low Cross-breds, (2) Medium Cross-breds, (3) Fine Cross-

breds, and (4) Merinos. Twenty years ago the Argentine clip was estimated to consist of 75 per cent. of Lincoln Cross-bred, giving a large percentage of long, strong, lustrous, preparing wool. There has since been a gradual tendency upwards due to the infusion of Romney and Down strains, as well as to the introduction of New Zealand Corriedales and, to a less extent, of Lincolns. The following list shows the types of wool produced in the principal Argentine provinces: coarse to medium, Buenos Aires; medium to fine, Entre Rios and Corrientes; fine cross-breds, Santa Cruz, La Pampas, Cordoba, Tierra del Fuego and Neuquen; merinos, Santa Cruz, Rio Negro and Chubut.

The Buenos Aires cross-breds furnish a large proportion of the strong preparing wools. The Southern types are the more esteemed as they have a desirable softness which is probably due to the influences of soil and pasture. The low cross-breds range from 36's to 46's, with a staple of 12 to 18 in. They are very sound and of smooth surface, and are largely used in the West Riding. The medium cross-bred wools vary from 44's to 50's, and considerable quantities of carding wools are produced. These wools are characterised by evenness and soundness of staple, but lack the full crimpiness and resilience of similar Australasian types. The type is largely founded on Lincoln x Leicester, a later transition having been effected by an infusion of Romney Marsh. The wools are good on the average, but except in special cases they have not yet quite attained the character of similar qualities produced in New Zealand or Australia.

The Entre Rios wools are chiefly fine and medium cross-breds and resemble Uruguay wools in style and general appearance. Much of the wool is from 50's to 58's quality, is often of good short combing length, and is useful where "blobbiness" and fullness are required.

The wools of Corrientes are less valuable than those mentioned above, and are often wasty and tender. They are chiefly from 50's to 60's in quality, and are more suitable for use on the Continent than in Great Britain.

In Tierra del Fuego a large variety of wools are produced which are readily marketable. The chief types are Romney, Lincoln and New Zealand Corriedales, with a sprinkling of Rambouillet Merinos. The wools contain much impurity owing to the high wind and loose nature of the soil, but have valuable properties and range in quality from 44's to 64's.

The sheep of Santa Cruz were originally Rambouillets from Rio Negro, or Lincolns from the Falkland Islands.

At the present time a fair quantity of merino comes from this region, and although not very attractive in appearance much of it forms a serviceable combing wool. A tendency to the occurrence of grey hairs is observed, and this should be remedied by the infusion of fresh blood and increased attention to rearing. These wools range in quality from 60's to 64's and are probably chiefly used on the Continent.

The wools of Chubut, although often of good quality, are unattractive in appearance owing to the presence of earthy impurity. The quality of the wool generally is superior to that of Santa Cruz and is truer to the merino type. It ranges mostly from 64's to 70's.

The wools of Rio Negro are chiefly merinos of the Rambouillet breed; the quality varies from 64's to 70's or even finer. It is considered that this immense region offers good possibilities for increased merino production.

Chile.—The principal wool of Chile is the type known as Punta Arenas which comes from the Chilean half of Tierra del Fuego. The types chiefly being developed are the Romney Marsh x Merino and the New Zealand Corriedale. The quality is very desirable and ranges from 50's to 60's. The wool possesses unusual resilience, "blobbiness," and crimpiness. Other Chilean wools, such as those of Lima, are largely of a miscellaneous, semi-wild character and contain some dead or coloured hair; they are therefore used principally for low woollens, or, if long and coarse, for the carpet and belting trades.

Uruguay.—The wools of Uruguay are generally known as "Monte Video," taking this name from the chief port from which they are shipped. A wide range of very attractive wool is produced, extending from 40's to 60's or even 64's. The principal breeds have been the Romney Marsh, Southdown, Lincoln and Rambouillet. Much of the wool is clean and of attractive appearance. The low wools are bright, sound and lustrous; the medium wools are perhaps preferred to those of Buenos Aires, and the fine cross-breds are very popular in Great Britain, the United States and the Continent. Merinos do not form a large proportion of the Uruguay clip, and those produced lack the rounded crimp and density of Australian merinos but are much in favour on the Continent.

Falkland Islands.—The wools from the Falkland Islands often have a Cheviot character and range chiefly from 40's to 56's. The infusion of Romney, Lincoln and Border Leicester blood during the last twenty years is gradually improving the type. The wool finds a ready market in London.

Photographs of the different wools and diagrams showing the variation of diameter in each case are provided.

The author has given some notes on the shearing, grading and marketing methods of South America which are of much interest.

Machine shearing is commonly practised throughout South America. Grading is becoming increasingly general and is carried out on the lines of the methods employed in Australia and New Zealand. The wool is purchased by the buyers of large wool-dealing firms and is graded under their direction; the different grades are then offered to various wool centres through agents appointed for marketing the wools. The objectionable practice of tying fleeces with jute string is still practised, although some stations have abandoned it. The wools are press-packed, stitched up in canvas, and bound with iron hoops. The bales usually weigh from 900 to 1,000 lb. each, but those from Punta Arenas and the Falkland Islands are only about 450 to 550 lb.

The output of South American wool has decreased greatly during recent years, the present production being only about 350 million pounds as compared with 500 million pounds twenty years ago. This decline is due to many factors, including the ruling of low prices for wool during certain periods and high prices for mutton and lamb which led to heavy slaughtering. The unprecedented slump of 1919–20 when values fell below the cost of production caused a reduction in large holdings and the ruin of many small farmers. It is considered, however, that improved prices and demand will lead to increased production in the next two or three years.

The Journal of the Central Bureau for Animal Husbandry and Dairying in India.—The first part of a new quarterly journal bearing this title has recently been issued by the Imperial Department of Agriculture for India, under the editorship of the Agricultural Adviser to the Government of India. The journal will deal with cattle breeding, dairying, cultivation and storage of fodder crops, animal nutrition and other aspects of animal husbandry.

In a foreword to the first part H. E. Lord Irwin, Viceroy and Governor-General of India, emphasises the great importance of scientific cattle-breeding. He states that although the Imperial and Provincial Departments of Agriculture in India have done much to improve animal husbandry and dairying, Government action is not enough, and the country must depend on the big landowners if real progress is to be made. He would like to see India's landed aristocracy follow the example of England's gentlemen farmers, through whose efforts England has become

the Stud Farm of the world. At present, he points out, the tendency of the educated classes in India is to immerse themselves in politics or the law, but education should be directed into practical channels, and it should be the first aim of all connected with the country to do everything that can be done to foster and improve the basic industry of agriculture on which India, more perhaps than any other country, is dependent.

The new journal should do much towards stimulating the interest of Indian landowners in animal husbandry. The opening article consists of a reprint of a lecture delivered by the Imperial Dairy Expert (W. Smith) at New Delhi on February 21, 1927, on "The Importance of Cattle-Breeding and Dairying Industry in India." Other articles in the first part are: "The Introduction of Foreign Milk Stock into India for Cross-Breeding," "A Veterinary Entomology for India" (the first of a series of articles dealing with insect pests of domesticated animals in the Indian Region), "Co-operative Dairying in Bengal," "The Rate of Propulsion of Food through the Alimentary Tract of Ruminants," "Poultry Breeding" and "Silage Experiments on Shisham Leaves," as well as reprints of articles from other periodicals.

The Journal is obtainable from the Government of India Central Publication Branch, Calcutta, and from all agents for the sale of Indian Government publications, including the Office of the High Commissioner for India, 42, Grosvenor Gardens, London, S.W.1. The subscription price is Rs. 2–8 per annum, including postage, and the price of each part As. 10.

Manganese and its Alloys.—At the recent annual meeting of the Iron and Steel Institute, two important papers on manganese were read by Sir Robert Hadfield. These were: (1) "The Metal Manganese and its Properties: also the Production of Ferro-Manganese and its History"; (2) "Alloys of Iron and Manganese containing Low Carbon." Special interest attaches to these papers on account of the author's pioneer research activities in connection with manganese and its alloys. It is, indeed, interesting to note that it was as long ago as 1888 that the author communicated his first papers on manganese-steel to the Institution of Civil Engineers and the Iron and Steel Institute, these being followed in 1893 by a paper on "Iron Alloys, with special reference to Manganese Steel." In these papers he described the discovery and invention of manganese steel, which is now defined as an alloy containing about 85 per cent. iron, 12 to 14

manganese, and 1 to 1½ carbon. The discovery of this product was not only important in itself as furnishing a new alloy of exceptionally valuable properties, but it opened up a new era of investigation of alloy steels and initiated a research movement which has proved by its results to have been one of great importance to modern industry.

Manganese finds its chief application in industry in the manufacture of the alloys of iron and manganese, the chief of which from the commercial point of view are ferro-manganese and spiegel, including silico-spiegel. Ferro-manganese is a generic term for the crude pig metal containing usually about 80 per cent. of manganese, though it may contain not more than 60 per cent. Spiegel ranges from 5 to 20 per cent. of manganese, but the higher percentages are those for which there is most demand. Silico-spiegel contains from 15 to 20 per cent. of manganese and about 10 per cent. of silicon. All these alloys contain carbon, the percentages of which average about 6 or 7 in ferro-manganese, 4 or 5 in spiegel, and usually less than 5 in silico-spiegel.

The presence of carbon is, in some respects, a disadvantage in experimental and research work; and in these papers Sir Robert Hadfield makes the very interesting statement that his discovery of manganese steel is attributable to the fortunate circumstance that, at the time he made his discovery in 1882, he was not able to obtain ferro-manganese low in carbon. Otherwise he would have made his experiments with the low carbon alloy and would probably have failed to discover that particular alloy which is now known as manganese steel, and which owes its peculiar virtues to the presence of an appreciable percentage of carbon.

Ordinary ferro-manganese contains carbon in the ratio of about twelve of manganese to one of carbon. Hence ferro-manganese containing 80 to 84 per cent. of manganese contains from 6 to 7 per cent. of carbon. Consequently, in the manufacture of manganese steel there must always be about 1 to 1½ per cent. of carbon in the steel, and upon this amount of carbon the valuable properties of the steel depend. The results of recent researches show that alloys of iron and manganese without carbon are apparently of no commercial value at present.

It is quite otherwise with certain other alloys of iron, some of which are not nearly so valuable when they contain about 0·5 per cent. or more of carbon as they are when the carbon is reduced to the lowest possible amount, say 0·1 per cent. or less. An example of this is silicon steel, the valuable properties of which depend on a low

percentage of carbon. The modern chromium-steel alloys, again, offer much more resistance to corrosion if carbon is absent or present only in low percentages ; and the same applies to the new types of nickel-chromium steel alloys.

In the first of the two above-mentioned papers, an interesting account is given of the production and properties of manganese and ferro-manganese. For the production of ferro-manganese high-grade ores are required and the smelting process is expensive, not only on account of the high price of the ore but also owing to high fuel consumption. When made in the blast furnace, ferro-manganese usually contains appreciable percentages of carbon, which it is almost impossible to eliminate. When produced in the electric furnace, however, the alloy can be obtained comparatively low in carbon. Moreover, the direct consumption of carbon by the electric furnace process of manufacture is much lower than in the blast-furnace process, amounting to only about 500 lb. per ton of ferro-manganese, whereas the blast-furnace process requires two or three tons of coke per ton of ferro-manganese.

In the production of ferro-manganese by the blast furnace the losses of manganese are very considerable. The average loss during the war at the ferro-manganese furnaces of the Steel Corporation in America is reported to have been 28 per cent., while that at the spiegel furnaces amounted to 30 per cent. According to the late J. E. Stead, the losses in 1920 in British practice amounted to 20 per cent., and a similar figure applies at the present time. From figures supplied by the Darwen and Mostyn Iron Company, it appears that for each ton of manganese in the ore smelted, a ton of 80 per cent. ferro-manganese is produced, which represents a loss of 20 per cent. The manganese thus lost goes mostly into the slag ; the remainder is carried away as flue dust and vapour ; and these products are of little or no value. In contrast with this loss involved in smelting manganese ore, it is mentioned that, in the reduction of an iron ore, such as hæmatite for example, there is no appreciable loss of iron in the production of pig iron.

In spite of the fact that the electric furnace process requires less carbon for reduction purposes and the claim that it permits of better control as regards the nature and grade of the product, it lacks efficiency on the whole. It demands a heavy consumption of current and is expensive ; and although silico-spiegel, spiegel and special qualities of ferro-manganese are at present produced by this process, it is more economical to produce ordinary ferro-manganese by the blast-furnace process.

The chief factor in determining the purity of ferro-manganese is the phosphorus content of the ore, rather than the process by which it is made. Reference is made by the author to a British ferro-manganese in which the phosphorus content is very low, for the purpose of showing that, with care and attention during the process of manufacture, there is no doubt that the blast-furnace method of production can well hold its own, and great credit is due to British makers for the way in which they have developed this important manufacture. The following is a list of British producers of ferro-manganese, together with the number of furnaces they employ, and their annual capacity :

	Number of Furnaces.	Annual Capacity. (Tons)
The Darwen and Mostyn Iron Co., Ltd.	5	75,000
Dorman, Long & Co., Ltd.	2	45,000
Linthorpe, Dinsdale Smelting Co., Ltd.	2	45,000
United Steel Co. (Workington Iron and Steel Branch)	1	25,000
Bolckow, Vaughan & Co., Ltd.	1	25,000
Wigan Coal and Iron Co., Ltd.	1	25,000
Total	12	240,000

Analyses of works deliveries of ferro-manganese show phosphorus contents ranging from 0·20 to 0·29 per cent. for ordinary blast-furnace products and 0·154 to 0·292 per cent. for special products of high and low carbon. As regards any improvement in the manufacture of ferro-manganese, there seems to be but little difference in the type and quality compared with that produced originally by the eminent French metallurgist Pourcel in 1875. The author points out, however, that for special purposes, ferro-manganese containing less than 0·05 per cent. of phosphorus would be very useful if it could be produced.

As regards production of raw material, the author deals at considerable length with the distribution of manganese ore, and points out that, in 1925, the British Empire produced 1,190,000 tons out of a world total of 2,700,000 tons, or 44 per cent. A remarkable feature in recent years is the large extent to which the Gold Coast Colony has contributed to the output, and quite recently important deposits have been discovered at Postmasburg in South Africa. The author points out that no country making steel on a large scale possesses the supplies of manganese ore needed for its industry. For fuller details on this interesting resources aspect of the subject, as well as on the history of the metallurgy of manganese, readers should consult the papers referred to above, from which, in this note, it has been possible to cull only a few extracts.

RECENT RESEARCH ON EMPIRE PRODUCTS

A Record of Work conducted by Government Technical Departments Overseas

One of the principal functions of the Imperial Institute is to serve as a Clearing House for the collection and dissemination of information relating to the production and utilisation of all classes of Empire raw materials. In order to fulfil this purpose it has been the practice to collect systematically and index the information contained in official reports, publications and technical journals, both British and foreign, and to utilise this information in dealing with enquiries and investigations, and for publication in this Bulletin, particularly in the sections on "Abstracts" and "Bibliography." The object of both these sections is to keep officers of technical departments overseas in touch so far as possible with the work carried out elsewhere on particular crops and products.

One disadvantage encountered in disseminating the results of the work of the agricultural and forestry departments in the Dominions, India and the Colonies is the fact that the printed annual reports do not reach the Institute until nine to twelve months after the period to which they relate. The information they contain is therefore not up-to-date when published in the Bulletin and may indeed have been modified by more recent work. With a view to obviating this defect and rendering the information given in the Bulletin as recent as possible the Director of the Institute proposed an arrangement whereby Directors of Agriculture and the Heads of other Technical Departments should send to the Imperial Institute twice yearly on fixed dates, say January 15 and July 15, a brief summary of the research on raw materials carried out during the previous six months, giving, in each instance, some estimate of the progress achieved. The staff of the Institute would analyse these reports and produce in the next number of the Bulletin a survey of the work done and the progress attained in each part of the Empire. The matter inserted would be arranged under headings of products so that an officer interested in a particular product could see at a glance what investigations had been made in regard to it elsewhere.

The Secretary of State for the Dominions and Colonies expressed his entire agreement with the Director's views and approved generally of the proposed arrangements. He accordingly asked the Governments of the Dominions and Colonies to consider whether the proposals could be

given effect to as from July 15, 1927, and as a result reports have already been received from several of the Colonies giving the results of research work conducted during the period January to June of the current year.

As indicated above, it is proposed to summarise the reports under products for publication, but in view of the fact that there has not yet been time to receive replies from many of the Colonies, it has been decided on this occasion to publish in full the limited number received up to the time of going to press.

The reports printed below relate to research in Sierra Leone, Nyasaland, Somaliland, British Honduras and Cyprus.

SIERRA LEONE

Mr. M. T. Dawe, the Commissioner of Lands and Forests, has forwarded the following reports:

(*a*) Précis of some of the more important Experiments and Trials at Njala Experimental Farm for period January to June 1927, by the Director of Agriculture.

(*b*) Résumé of the work of the Division of Research from January to June 1927, by the Agricultural Chemist.

(*c*) Some recent work on insect pests in Sierra Leone, by the Entomologist.

I. Précis of some of the more Important Experiments and Trials at Njala Experimental Farm, Sierra Leone. January 1 to June 30, 1927.

(1) *Manurial Trials*

Tests are being made with certain artificial manures, lime and bulky organic manures (pitstuff) on certain permanent and annual crops.

Limes.—One section of the plantation was treated with a dressing of sulphate of ammonia, superphosphate and potash; one with lime, and one was left as control. There was no appreciable difference in yield between the limed and control sections, but that of the manured section was more than trebled over either of the other two.

Coffee.—One section of the plantation of *Coffea stenophylla* was manured with sulphate of ammonia, superphosphate and potash, the other was left as control. The yield of the manured section was rather more than double that of the control.

Annual Crops.—Trials are now in progress on ginger, rice, ground-nuts and cassava.

The ginger, rice and ground-nut trials are on two-acre plots divided into twenty one-tenth acre sections and the

effect of nitrogen, potash and phosphate with and without the addition of lime are being tried. For the purpose of trying the effect of each manure plots are being manured with a combination of all three as a complete manure, and the complete manure less one of each of the three in turn; half the plots under each treatment are also being treated with lime in order to eliminate acidity as a factor in the trials.

The manurial trials on cassava are on a four-and-a-half acre plot divided into thirty-six one-eighth acre sections. Seven different manurial treatments are being tried:

1. Lime.
2. Pitstuff.
3. Lime and pitstuff.
4. Potash.
5. Lime, pitstuff and potash.
6. Lime, pitstuff, ammonium sulphate and superphosphate.
7. Lime, pitstuff, ammonium sulphate, potash and superphosphate.
8. Control.

(2) *Rotation Trials*

A series of rotation trials was started last year on land which had been under continuous cultivation since 1912, only having received periodic dressings of pitstuff and green manure. A four-course rotation is being tried on four one-acre plots, as follows:

A. Green manure crop.
   Rice.
   Soya beans.
   Yams.

B. Cassava.
   Legumes.
   Rice.
   Ground-nuts.

C. Ginger.
   Cotton, sown August preceded by green manure crop.
   Legumes.
   Rice.

D. Rice.
   Ground-nuts.
   Ginger.
   Pigeon pea.

The four plots were sown this year in April and May with the following crops: rice, pigeon pea, green manure crop (cotton crop to follow in August), and ground-nuts.

(3) *Cotton*

Trials are in progress on various varieties of cotton with a view to discovering a variety suitable to Sierra Leone. The varieties under test include for the present Allen Long Staple, Lengupa, Cambodia, Sunflower and selected varieties of Ishan from Southern Nigeria. Seasonal trials are also being carried out with a view to discovering the best time to sow. The following cottons have been sown: Lengupa, Sunflower and Quande. The climate of Sierra Leone is divided into two distinct periods, viz. rains from May to October with about 80 to 90 in. of rain, and dry from November to April with approximately 15 to 20 in. of rain. The object is to establish (*a*) a long season cotton that will be planted in June or July and yet withstand the heavy rains, or (*b*) a short season cotton that when planted in August or September will come to maturity by January.

Seed selection on the indigenous "Quande" cotton has been in progress for the last two seasons. There has been a marked improvement in the quality of cotton.

(4) *Permanent Crops*

Trials are in progress with Sierra Leone and Dominican limes, with Stenophylla, Robusta, Canephora and Liberica coffee, and with Canary bananas and plantains, with a view to finding out particulars with regard to amount of crop, cultivation and cost of production. Comparative tests are being made with Uba (Canary Island) sugar cane and the native cane.

Orange, grapefruit and avocado pear plantations have been laid down of selected grafted stock with a view to acquiring information helpful in starting an export fruit industry for the country and raising grafted stock of the varieties best suited to the country for starting plantations with a view to exporting fruit.

A locally discovered banana, said to be similar to the Lacatan banana of the Philippine Islands which is immune to Panama disease, is being grown to discover whether it may also be immune.

(5) *Other Crops*

Trials have been carried out with various varieties of tomatoes to discover their suitability or otherwise to the country, and similar trials have been started with onions.

Seeds of various economic crops have been imported and grown both to test their suitability to the country and to increase supply of seed.

Trials are being made with various "cover crops" most important to this country; among these may be mentioned velvet beans, pigeon pea, Calopogonium and efwatakala grass; the latter is also being tried as a fodder.

II. Résumé of Work of Division of Research, Sierra Leone. January to June, 1927

(1) *Chemical Section*

The work of the chemical section has been mainly devoted to soil investigations, but other problems connected with oil palms and piassava have also received attention.

Soil Investigations.—Since the opening of the chemical laboratory in 1925 over 1,000 samples of soil have been received and examined, and as a result of these analyses it has been possible during the last six months to draw up descriptions of our local types. These in the main are of a lateritic nature and the two common types are a red gravelly laterite soil and a brown sandy soil. The red gravel soils contain a high proportion of lateritic concretions (from 30 to 70 per cent.) and these concretions contain a high proportion of iron (30–50 per cent. Fe_2O_3). The soils are acid in reaction but the organic matter is generally low (2–4 per cent.). The sandy soils usually contain a high proportion of the "coarse sand" and "fine sand" fractions, and, like the gravels, are acid in reaction and low in organic matter. The lateritic nature of the soils is being investigated and it is hoped that the results of these investigations will be published shortly.

The Provincial Superintendents of Agriculture, working in collaboration with the chemical section, continue to submit samples of soil from their Provinces, and gradually the distribution of the soil types throughout the Colony and Protectorate is being worked out. The results of these examinations are recorded yearly in the *Annual Report of the Lands and Forests Department.*

Oil Palm Investigations.—These are being carried out in collaboration with the Mycologist. The various indigenous and imported varieties grown at Njala are subjected to routine examinations. The yields from each palm are recorded separately and where necessary the proportions of oil and kernels present in the fruit are determined in the laboratory. This has resulted in showing the presence

of a variety of types both with thick and thin shelled nuts and with varying proportions of pericarp.

The oil palm fruits fall into four main groups: thin shelled, medium shelled, thick shelled and mantled fruits; some of the thin shelled types are very promising and over 50 per cent. of pericarp oil was obtained from the fruits of one of these trees.

The yields this year are heavier than last and more evenly distributed throughout the year, while from the heads already harvested and those still on the trees it is estimated that the yield of fruit will be from 22 to 25 cwts. of clean fruit per acre from the plantation now in its seventh year.

Compared with last year the yields for the first six months are as follows:

	1926. lb.	1927.
Clean fruit, per acre	1,140	1,324
Heads still on trees June 30, per acre	134	284

Various types of cover crops are being used to prevent soil erosion; they include sweet potato (for the young stages), *Desmodium adscendens* D.C. (a leguminous plant) and various native grasses of which the chief are *Axenopus compressus*, *Paspalum conjugatum* and *Digitaria horizontalis*.

Piassava.—The reports of the Imperial Institute and Mr. T. A. Unsworth of Messrs. E. B. and C. Whiting and Co., Burlington, Vermont, U.S.A., on the samples prepared and submitted by the Agricultural Chemist were considered at a Conference between the Local Chamber of Commerce and members of the Department, and a leaflet of instructions on the preparation of the fibre was drawn up while regulations governing the inspection of the fibre are under consideration.

(2) *Mycological Section*

In addition to the oil palm work which is carried out by this section the following mycological records are of interest: *Tolyposporium penicillariæ* Bres. on bulrush millet; *Thielaviopsis* (? *T. paradoxa*) on oil palm; "Crown Disease" as described from Sumatra on oil palm; *Piricularia* on rice and *Eleusine indica*; *Theissenia pyrenocrata* (Theiss. ?) Maubl. on *Poinciana regia*; *Oidium* on Zinnia and Impatiens; *Rhizoctonia* on beans, turnip leaves and "Bush Green" (*Amarantus caudatus*) leaves; *Diplocarpon rosæ* (Lib.) Wölz. on rose leaves; *Cintractia leucoderma* (Berk.) P. Henn. on *Rhyncospora aurea* Vahl.; *Fomes lignosus* (Kl.) Bresad. on *Eriodendron anfractuosum*;

Fomes pachyphlœus Pat. on *Parinarium excelsum*; and *Pucciniosira anthocleistæ* P. Henn. on *Anthocleista parviflora.*

III. Some Recent Work on Insect Pests in Sierra Leone

(1) *The West African Locust* (*Zonocerus variegatus*)

Occurrence.—This insect is a very serious annually recurring pest in Sierra Leone, and its damage, which is widespread, is difficult to estimate. It must be enormous, as it is a common sight to see acres of cassava, an important native source of food, completely defoliated, and many other crops, including banana, castor bean, citrus, cocoa, coconut, coffee, cotton, ginger, kola, yams and vegetables. This gives an idea of its omnivorous nature, and when hard put to, it will consume mango, both fruit and leaves, various kinds of palms, and almost any vegetation.

Control.—In view of the widespread damage it was important that some remedy of simple application should be found. This work was commenced in November 1926, and as these insects appeared to show a desire for common salt, it was decided to try this substance as the attractive element in a poison bait. Rice hulls suggested themselves as the carrier, and experiment was made with various preparations of the hulls and salt, with Paris green as the poison. Honey and lime juice were also separately used as attractants, but the salt was preferred. It was found that 2 lb. of salt to a bushel of carrier was preferred to 4 lb. and it is possible that less salt may be effective, but there has not been opportunity to test this thoroughly. With regard to the carrier, it was so difficult to get a uniform mixture with rice hulls, that sawdust was substituted, and this worked admirably.

The mixture used therefore consists of:

(1) Sawdust	1 bushel (about 17 lb.).
(2) Paris green	1 lb.
(3) Salt.	2 lb.
(4) Water	5 quarts.

To prepare the mixture (1) and (2) are thoroughly mixed dry, the salt incorporated, then the water added, and the whole thoroughly mixed so as to obtain a uniform distribution of the constituents.

If Paris green is not available, lead arsenate may be substituted at the rate of 3 lb. per bushel of sawdust.

The mixture is broadcast as thinly and uniformly

as possible over the infested area, and, with practice, one bushel is sufficient for two acres.

After three days all the hoppers were killed, and it was also noted that after the insect had consumed some of the bait, feeding ceased.

It is best to apply the bait early in the season, as the young emerge from the breeding grounds in certain limited areas, so it is a great advantage to deal with them before they have spread and done damage. It must be remembered that a shower of rain removes the attractive part of the bait.

Efforts have been made to ascertain the characters of the breeding grounds of this locust, but up to the present without success. It is practically certain that they are rather specialised and, as a result, one finds a definite movement to food plants when the young emerge from the bush, and a similar movement, towards breeding grounds, at the end of the season. At Njala, where observations were made, these directions were almost East and West respectively, but whether or not this is general is not yet known.

Cannibalism.—Experimental evidence is available proving that this species has cannibalistic habits, even in the presence of suitable food, and during a period of six days, 20 out of a total of 200 hoppers had been eaten. This probably has some bearing on the ultimate effect of the poison bait. There was no cannibalism amongst poisoned individuals.

(2) *Ginger*

The main work on this crop has been in connection with a scale insect which attacks the rhizomes both in the field and in store. Experiment was made to find how these insects affected the product and particulars are given below.

Plots were planted, one with infested stock, the other with some of the same material which had been subjected to fumigation with hydrocyanic acid gas for a period of $1\frac{1}{2}$ hours, potassium cyanide being used for this purpose at the rate of one ounce per hundred cubic feet.

Although the plots were only $\frac{1}{32}$ acre, the results are considered to indicate the harmful effect of this scale insect. The treated stock gave a much better stand than the other and was free from scale on harvesting, the untreated being heavily infested. The rhizomes from the two plots were stored separately for a period of four months and again weighed, the resulting loss in weight being due to evaporation and scale insects, the difference in percentage loss being attributed to the latter. The ginger was planted

on June 2, 1926 (late in season) and harvested on February 19, 1927. The loss due to scale during growth was 65 per cent.

The two lots were weighed again on June 27, 1927, with the following results :

	Per cent.
Decrease in weight of ginger from treated stock . . .	54
„ „ „ „ „ „ untreated „ . . .	68

The difference in loss during storage therefore is 14 per cent., representing the action of the scale insects.

The total loss of weight according to these figures, due to scale attack, is therefore 79 per cent.

The infested product after a storage of four months is commercially valueless, so that the actual loss may be put at 100 per cent.

(3) *Kola*

The main points in connection with this crop are insects affecting the nut, and the Psyllid *Mesohomotoma tessmanni*, attacking the young growth, including flower buds.

There is nothing new to report during the past six months, except that some pruning experiments have been commenced to see what influence they may have on pests and their control.

With regard to the kola nut weevil (*Balanogastris kolæ*), no infestation has been found in sound pods on the tree but only in pods which have fallen, and it appears certain that infestation to the alarming extent that occurs in the trade originates in the inclusion of a few or more wind-fall nuts, further aggravated by conditions under which the nuts are stored. The weevils breed very rapidly, the minimum period under laboratory conditions from emergence of adult to emergence of adult of the next generation being only 22 days.

(4) *Nematodes*

These seriously affect tomatoes in Sierra Leone, and it is likely that other crops will be found to suffer.

No work on this subject has been completed, but tests were made with carbon bisulphide, 15 cc. being poured into holes of 8 in. in depth at distances of 9, 12, and 14 in. respectively from the plant, and also with surface application of lime at the rate of 67½ cwts. per acre. There was indication that lime would prove very useful, and that benefit would have been derived from the carbon bisulphide had it been applied earlier in the growth of the plants.

(5) *Termites*

Certain plants, such as cacao, coconut and citrus, are liable to attack by termites, often causing serious damage.

In December, 1926, a number of coconut palms and citrus trees of various kinds were painted with an arsenical mixture, and this has proved effective throughout a period of six months, including the early part of the rainy season.

The paint was made up of:

	lb.
Quicklime	1
Lead arsenate	½

The quicklime is slaked in as little water as possible and then reduced to the consistency of thick cream. The arsenate is separately mixed with water, the latter being added in small portions so as to produce a uniform smooth paste, of a creamy consistency. The two are then thoroughly mixed. (*N.B.*—This mixture should not be prepared or kept in a metal container).

The tree should first be cleaned from 2 to 3 in. below ground level to a height of 2 ft. above, and the mixture carefully and thoroughly applied by means of a brush so that every part is covered. When dry, the soil is replaced.

NYASALAND

I. Investigations with Special Reference to the Growth of Tobacco

By A. J. W. Hornby, B.Sc., D.I.C., Agricultural Chemist

(1) *The Nitrogen Problem*

The loss of nitrogen in Nyasaland soils is very serious and constitutes one of the most important problems to be dealt with in the country. The supply of nitrogen is often the determining factor in growth during the average growing season in the Highlands.

The lines on which this problem is being tackled are:

(*a*) Supply of nitrogen and organic matter in rotations as indicated in Bulletin No. 2 of 1924 (Likangala series), and maintenance of the balance between nitrogen and other constituents for bright tobacco soils.

(*b*) Intelligent application of soluble nitrogen salts both before planting and to the growing crop; yields in many cases have been doubled by the latter procedure.

(*c*) Inoculation of roots of leguminous plants by cultures at sowing; cultures were obtained from the United States and used successfully on soya beans, lucerne and clovers.

(*d*) Better utilisation of organic residues, such as cattle manure and cotton seed.

(*e*) Use of highly concentrated synthetic fertilisers and their effect on the quality of the leaf. In this connection, urea with 46 per cent. nitrogen, and Diammonphos with 20·6 per cent. nitrogen and 52·5 per cent. phosphoric acid, are being used on tobacco this season. With a unit value of 17*s*. for nitrogen at Limbe, they are the cheapest of nitrogenous fertilisers.

(*f*) Nitrification and liming. Laboratory work has included investigations into the rate at which the nitrogen is rendered available on a typical Ntondwe sandy loam. The results are as follows :

	Amount of sulphate of ammonia applied per acre.	Amount of nitrogen added.	Pounds per acre of nitrogen as nitrate on mulched soil.			
			At time of application.	After 12 days.	After 6 weeks	After 10½ weeks.
	lb.	*lb.*				
1.	nil	—	27	27	46½	48½
2.	300	63·6	27	31½	77	88½
3.	300	63·6	27	30½	85½	87
4.	300	63·6	27	30½	96	95½

Plots 1 and 4 received 2,000 lb. of lime to the acre, which obviously accelerated nitrification very little. Further experiments on the same lines proved that half the nitrogen supplied as sulphate of ammonia is converted into nitrate after 40 days when the soil moisture is kept at 10 per cent.

(2) *Absorption by Soils of Ammonia applied in Fertilisers*

The following figures were obtained in the course of investigations into the loss by leaching of ammonia salts applied to bright and dark tobacco soils :

Expt. I. One hundred grams of several types of soil were treated with 200 cc. of 0·1 per cent. solution of ammonium sulphate for 2 hours, with frequent stirrings. The mixture was filtered after 2 hours.

Soil.	Amount of ammonia added.	Amount found in filtrate.	Amount absorbed.		Amount lost.
	mgms.	*mgms.*	*mgms.*	*Per cent.*	*Per cent.*
Tuanjati sandy loam . .	51·6	24·8	26·8	51·9	48·1
Ntondwe red loam . .	51·6	22·7	28·9	56·0	44·0

Expt. II. One hundred grams of same two soils treated with 200 cc. of 0·1 per cent. solution of ammonium sulphate for 24 hours :

Soil.	Amount of ammonia added.	Amount found in filtrate.	Amount absorbed.		Amount lost.
	mgms.	*mgms.*	*mgms*	*Per cent*	*Per cent*
Tuanjata sandy loam . .	51·6	22 7	28·9	56·0	44 0
Ntondwe red loam . .	51·6	21·9	29 7	57·5	42 5

Expt. III. Two grams of the sulphate of ammonia were then mixed with 100 grams of each of the soils and 200 cc. of water added little by little with stirring. After 2 hours the solutions were filtered, and the filtrates analysed with the following results :

Soil	Amount of ammonia added	Amount found in filtrate	Amount absorbed		Amount lost
	mgms.	*mgms*	*mgms*	*Per cent*	*Per cent*
Tuanjata sandy loam . .	51 6	29 9	21 7	42 1	57·9
Ntondwe red loam . .	51 6	23·7	27 9	54 2	45 8

Expt. IV. This experiment was to ascertain the amount of fertiliser leached from an average tobacco soil with which it was incorporated when a quantity of water equivalent to 2 in. of rainfall was added during 2 hours.

Sixty-five grams of fertiliser were incorporated with the upper 3 in. of various soils and 600 cc. of water added, which was in every case absorbed.

Twenty-four hours afterwards a further 300 cc. of water was added and the water percolating through was analysed. 100, per cent. of the ammonia was absorbed by this soil initially dry. Similar results were found for Diammonphos or ammonium phosphate, but in the case of nitrate of potash applied in a similar way, only 93 per cent. was absorbed by the upper 3 in. of soil with a rainfall of 3 in.

The above experiments show that ammonia salts are absorbed by Nyasaland soils to the same extent as by similar soils in Ceylon and Mauritius (see *Bulletin No. 75, 1926, Ceylon Department of Agriculture*), and the advantage of using such ammonia salts instead of the more easily leached nitrate fertilisers for our growing season should be borne in mind. The need of further lysimiter

experiments on these lines through a growing season is obvious.

(3) *Accumulation of Nitrate in the Soil*

The accumulation of nitrate on well cultivated land during the dry season is seen in the following figures obtained during September and October, 1926:

	Well and early cultivated land.	Badly worked soil.
Average no. of pounds per acre of nitrogen in nitrate form, and therefore directly assimilable by plants (nine samples of each)	27½	11½

A further example of the difference in nitrate accumulating on cultivated soils of different ages is seen below:

	lb. per acre of nitrogen as nitrate.
Newly opened virgin soil	9·8
Land after 4 years in cropping	19·1
,, ,, 1 year ,, ...	33·8
,, ,, 2 years ,, ...	24·0

Treatment and origin were very similar during the dry season of 1926. The difference in growth on land of these different ages is thus explained.

It is obvious as a result of these investigations that more attention should be paid to early dry-season cultivation to promote nitrification and aeration for tobacco growing.

(4) *Tobacco Investigations*

(a) *Absorption of Nitrogen by the Tobacco plant*

The tobacco plant absorbs most of its nitrogen as nitrate and the requirements for this element are high.

I have carried out experiments regarding the manner in which the tobacco plant absorbs its nitrogen and find that under similar soil and climatic conditions the absorption goes on in a similar way to that in the American Old Belt.

The acquisition of a plot of land for experimental purposes in Zomba will now make it possible to gain further information on these lines, together with information regarding water supply and root development under healthy and root disease (eelworm) conditions. The following table shows results obtained with series of plants grown in the same seed-bed and planted out together. The plants were taken at intervals during growth up to the period when the plant showed true ripening; 36 days after topping and 97 days after late planting out, the ripe

bottom leaves were removed. Urea was applied 25 days after planting out.

The figures show the milligrams of nitrogen found in leaves, stems and roots. Variety used was Melton. Seven leaves were taken at each sampling after topping.

Age in days from time of sowing seed.	Leaves.	Stem.	Roots.
80	27·7	4·12	5·76
93	69·6	7·12	6·58
118	350·1	28·4	44·0
130	725·0	85·8	87·8
150	1,219·6	137·0	235·5
160	1,676·4	—	—

Full details of other experiments and of results with plants showing true, false and starvation ripening, under varying seasonal conditions will be published in course of time. The absorption of nitrogen during the true ripening is shown to be high, but there is very little absorption of nitrogen in the later periods of growth when the plant is topped and the characteristic ripening of the Bonanza varieties (i.e. Hickory Pryor of Rhodesian origin), is exhibited a few days afterwards, or when harvesting of lower leaves takes place before topping with White Burley and kindred varieties, such as White Burley crosses which are grown for colory tobacco with little body.

As regards the influence of small side applications of nitrogen to tobacco in the field, it is not thought that this will influence the aroma of tobacco to any extent.

In this connection the following communication from Dr. Garner may be cited. "I am still inclined to the view that the resins are the most important group of constituents influencing aroma."

The table given below shows the increases in yield which have been obtained with small applications of ammonia and nitrates to tobacco in the field.

This practice was commenced by me in Nyasaland in 1921. Good results have more particularly been obtained with varieties of the Bonanza class like the Hickory Pryor of Rhodesian origin. White Burley, however, does not seem to respond so well to such nitrogenous dressings, but colour is easily obtained.

As I have pointed out, colour is more easily obtained with the Bonanza class with smaller applications of phosphate and when the characteristic ripening occurs.

In applying the mixed fertilisers to soil types according to the formulas recommended, it is now the custom to apply phosphates, potash and organic nitrogen compounds after planting.

Year.	Soil series.	Fertiliser.	Application, lb. per acre.		Plot with no ammonia. Average of lb. per acre.	Ammonia fertiliser plot, lb per acre.	Increase in yield.
1921	Cholo .	Sulphate of Ammonia	100	L	328	403	75
1921	Ntondwe.	"	75	L	786	854	68
1921	Cholo .	"	75	L	391	511	120
1922	Ntondwe.	"	75	E	549	570	21
1922	Likangala	"	100	L	432	510	78
1922	Ntondwe.	"	100	L	213	236	23
1923	Likangala	Nitrate of Potash	112	E	496	589	93
1923	"	Nitrate of Lime	112	E	496	620	124
1923	"	Nitrate of Soda	100	E	496	580	84
1923	Ntondwe.	Sulphate of Ammonia	50	L	420	490	70
1923	"	Nitrate of Lime	150	E	330	296	34
1923	"	Nitrate of Soda	100	L	322	655	333
1924	"	Nitrate of Lime	100	L	402	498	97
1924	"	Nitrate of Potash	100	L	402	531	129

Much was learnt during these trials as to the correct time of application for bright and dark tobacco, especially from the point of view of the nature of the soil.

The increase due to a small application of a nitrogenous fertiliser is about 80 lb. per acre. In most cases there was decided improvement in quality, and the average increase in acre value of the tobacco was more than £4. The cost of the small applications averaged 17*s*. per acre, but the reduced cost of these applications and the increased knowledge of nitrification and of fluctuations in the nitrogen supply to the plant have increased the profit per acre to a large extent during recent years.

Even in 1921, two plots receiving ammonia yielded 1,080 and 1,010 lb. per acre in comparison with 578 lb. per acre for the plots receiving no ammonia but similar potash and phosphate. In 1926, the profits on an acre of tobacco due to sulphate of ammonia were £9 to £10 an acre greater than the profits on an acre unmanured.

It is hoped soon to have facilities for dealing more carefully with yield, so that the amount, number and value of the different grades from each plot may be carefully estimated and the increase in profit accurately ascertained.

This is a matter entirely for an experimental station supervised by a whole-time investigator, as in America.

(b) *Tobacco—Ripening*

Much attention has been paid in the field to the false ripening, as I have called it. This, as I have said, may be exhibited by special varieties or be due to nitrogen or magnesia hunger due to excessive rainfall, and there is no large starch accumulation in the leaves such as is characteristic of the ripening of nearly all American bright tobacco. The smaller amount of starch in some Nyasaland tobacco leaves has been well brought out by analyses. At lower elevations more suited to tobacco growing and with a smaller rainfall, true ripening is usually seen with standard varieties. It is obvious, from the superior way that certain varieties grow in some districts and from the characteristic way they ripen, that most successful results should be obtained from acclimatised varieties cross-fertilised from Burley and standard varieties, such as those of the Bonanza class, "Hickory Pryor," etc.

At lower elevations (below 2,800 ft. above sea level), which are most suitable for bright tobacco growing, the superior results obtained in some years when ripening goes on in a fairly dry month, as in America, should be compared with the early planting which often means ripening in a wet March. This especially applies to the Lake area and deserves thorough investigation in these areas. The growing of varieties for seed production should be on a station at about 2,200 ft. The narrowing of the leaf, etc., at much higher elevations is obviously owing to the checks in growth through extreme changes in temperature and plant food.

The effect of available soil phosphates on ripening and colour of standard varieties of tobacco has been studied.

The influence of phosphates on root development, fibrous tissue, quality, resistance to diseases and hastening maturity, is well brought out on some soil series such as Tuanjati, Vua, Lintipe, whose richness in available phosphorus has been confirmed in 1926 by soil analyses and field tests.

In the latter connection, I have in field work adopted Shedd's test and found it particularly useful (see *Soil Science*, Vol. XL, No. 2, February, 1921). Similarly in this extension work I have adopted for soil acidity, Comber's test, using 60 per cent. methyl alcohol, 40 per cent. acetone as the organic solvent (see *Journal Amer. Soc. Agron.*, July, 1925). This gives very useful indications for lime requirements of Nyasaland soils; 500 of these tests have been carried out after correlation with other determinations.

II. Investigations by the Government Entomologist

January–June, 1927

By Colin Smee, D.I.C., F.E.S.

(1) *Tobacco*

The Snowy Cricket, *Oecanthus pellucens* Scop., proved to be a serious pest of tobacco under certain climatic conditions, i.e. heavy concentrated rainfall. This insect hitherto appears to have been recorded as of minor importance (Sorauer), and other species of the same genus are recorded as being carnivorous.

The larva of the weevil, *Dereodus recticollis* Mshl., is a potential pest of tobacco, boring in the stems of small plants in the field. Alternative food plants so far found are cotton and ground-nuts, and the intensity of attacks on tobacco may prove to be correlated with the use of these two crops in rotation with tobacco.

The time of appearance of eelworm in tobacco nurseries appears to follow the first heavy rains of the season, the previous artificial watering not affecting any encysted or other stage in which the nematode has passed the dry season. This pest is very difficult to deal with under local conditions, owing to the very large areas under the one crop, the limited sites for tobacco nurseries, and the scarcity of exportable paying crops that could be used in rotations.

(2) *Tea*

The acclimatisation of an Indian jat in Nyasaland requires considerable attention.

Mosquito bug, *Helopeltis bergrothi* Reut., shows indications of doing more damage to Indian jat than to the local kind, and though at present really serious damage has not been caused by this insect, its potentialities must not be overlooked.

A new species of weevil, *Dicasticus mlanjensis* Mshl., devours the foliage of young tea plants and the grubs feed in the roots.

Root diseases are prevalent ; in addition to *Armillaria mellea* and *Ustulina zonata*, against which stumping and trenching campaigns are employed, a condition of ill-health of the bushes, of which the cause is at present unknown, is giving considerable trouble.

Macrophoma theæ Speschnew., has caused a quantity of "die back," particularly in nurseries of Indian jat.

(3) *Coffee*

The stem borer, *Anthores leuconotus* Pasc., can be destroyed without damaging the bush, by pushing crystals of paradichlorbenzene into the burrows.

Thrips, which, owing to the long dry season experienced in Nyasaland, may be expected to appear every year, can be controlled by spraying with a solution made from soaking the green leaves and shoots of *Tephrosia vogelii* (the local fish poison plant) in water. The addition of a spreader increases the efficiency of the solution.

BRITISH SOMALILAND

The following reports on Agriculture and Geology in this Protectorate for the six months ending June 30, 1927, have been furnished by Dr. R. A. Farquharson, Director of Agriculture and Government Geologist.

I. Agriculture

The Director of Agriculture only entered upon the duties of his office at the end of last year. Owing to the primitive state of native agriculture in the country, and the total absence of any European or other systematic cultivation, some time must elapse before any results of experiments in improved methods of tillage and in the growing of various crops can become manifest. Under the existing circumstances, at the beginning a considerable amount of preparatory work is indispensable, both in connection with Government experimental plots and in influencing the native garden-owners towards improved methods by practical demonstration of the use and advantages of new implements and practice.

Early in this year, a definite agricultural policy for the Protectorate was laid down, of which the chief elements were: (1) the introduction of improved methods of tillage and agricultural practice; (2) improvements in the quality of the crop (Sorghum) which the natives are accustomed to grow; (3) introduction of better pasture and fodder grasses and fodder plants; (4) introduction of an easily-grown simple rotation crop for which there is a local market; and (5) introduction of easily-grown crop plants for which there is an assured market on export.

So far, experiments have been carried out to ascertain the most suitable light plough and harrows for native conditions; several owners of plots have been taught to use them themselves without assistance, and sufficient interest has been awakened in regard to them to warrant

the introduction of a number for purchase. One or two small Government plots have been prepared for trial of (*a*) varieties of the native crop plant (Sorghum) that have proved commercially successful elsewhere, (*b*) a suitable simple rotation crop that can be used locally, (*c*) one or two easily-grown plants of which the crop is of export value, (*d*) one or two imported drought-resisting pasture and fodder grasses and a more or less drought-resisting lucerne, and (*e*) a few decorative and shade trees.

Seeds of these have begun to arrive, but as the rainy season is more than half over, little planting can be done until next year. In the meantime, steps are being taken to extend the area of demonstration and adoption of improved tillage implements and practice, as on these ultimately very largely depends any permanent improvement in native agriculture.

II. Geology

Owing to the necessity of concentrating attention on a sound beginning for the agricultural programme, there has been little opportunity during the last six months for geological research. A syndicate has carried out vigorous prospecting work on a concession for muscovite mica some thirty miles south of Berbera and some specimens of good quality have been obtained. As a result, an expert in mica mining was engaged to report on the commercial prospects of the area and there is reason to believe that the report was favourable. By request, the Government Geologist twice visited the concession and discussed both with the prospector and the mica expert matters relating to the geology of the area, method of working the dykes, transport, etc., with a view to development.

A prospecting licence has been taken out for the area of the galena occurrence south-east of Las Khoreh and work will probably be begun at the end of the year.

The regulations in connection with the development of the Dagah Shabel Oil-field are virtually complete.

BRITISH HONDURAS

The following report on forest research carried out in connection with the Forest Trust of British Honduras since its formation has been furnished by Mr. Duncan Stevenson, Acting Conservator of Forests.

In transmitting the report, Mr. Stevenson points out that since 1922 the trained forest staff has been so fully occupied in the exploration and organisation of the hitherto neglected Crown Forests that research has been restricted

almost entirely to the collection of statistics and experiments to determine the silviculture of Mahogany and Sapodilla.

Forest Research in British Honduras

I. Timbers

(1) *Publications*

The Imperial Institute has published in the *Bulletin of the Imperial Institute* reports on the following timbers of which the revised botanical names should be noted :

Mechanical Tests

Vol. XXI (1923), No 4, p 569	
Banak	*Virola merendonis* Pittier
Santa Maria	*Calophyllum Calaba* Jacq
Salmwood	*Cordia alliodora* (R & P) Cham.
Black Poisonwood	*Metopium Brownei* (Jacq) Urb
Vol. XXII (1924), No. 1, p 1	
Bullet Tree	*Bucida Buceras* L
Nargusta	*Terminalia* spp
Pine	*Pinus caribæa* Mor
Tubroos	*Enterolobium cyclocarpum* (Swartz) Gris.
Vol. XXII (1924), No 4, p 397	
Waika Chewstick	*Symphonia globulifera* L f
Quamwood	*Schizolobium parahybum* (Vell) Blake
Cotton	*Ceiba pentandra* (L) Gaertn
White Moho	*Belotia Campbellii* Sprague
Cypress	*Podocarpus coriaceus* Rich
Sapodilla	*Achras Sapota* L
Vol XXIII (1925), No 1, p 4	
Balsa Wood, Polak	*Ochroma bicolor* Rowlee.

Paper-Making Tests

Vol XXIII (1925), No 1, p 12	
Quamwood	See above
White Moho	See above
Polak	See above

An article on the natural habit of Banak, Santa Maria, Yemeri (*Vochysia hondurensis* Sprague) and Tamarind (*Pithecolobium arboreum* (L.) Urban, and *Acacia glomerosa* Benth.), by Assistant Conservators of Forests, British Honduras, appeared in *Tropical Woods* (Yale), No. 4, 1925, and was reviewed in *Bulletin of the Imperial Institute*, Vol. XXIV (1926), No. 1, p. 56.

A note on the use of secondary woods for sleepers by the Superintendent of British Honduras Railway in *Tropical Woods*, No. 7 (1926), p. 30, was reviewed in *Bulletin of the Imperial Institute*, Vol. XXIV (1926), No. 4, p. 705.

(2) *Mahogany* (*Swietenia macrophylla* King), *and Cedar* (*Cedrella mexicana* Roem.)

(i) Extensive experiments in applied silviculture of mahogany have been carried out in the Southern Districts and may be summarised as follows :

(*a*) Silviculture with special reference to reproduction in climax types.

(*b*) Silviculture in the Broken Ridge and Acache types of the north.

(*c*) Defoliators and shoot borers attacking improved seedlings.

(*d*) Ambrosia beetles (pinworms) attacking logs during extraction.

(*e*) Balsa woods used as shelter crops for mahogany regeneration, a modified condition of which is introduced under a broken canopy of High Bush species in (*a*).

(ii) One mahogany tree per acre is at present accounted good stock and silvicultural operations have been started in several parts of the Colony in order to produce up to 30 trees of exploitable size per acre, and the indications are that this objective will be reached.

A detailed note on the silviculture of mahogany with full reference to the experimental methods leading up to the present method in force is being prepared for publication in the *Empire Forestry Journal*, but the latest improvement operations may be shortly summarised.

Tree Improvement consists simply in the freeing of the crowns of mahogany and cedar, and in some cases the more important secondary woods, from creepers, which are cut at 6 ft. from the ground and rot off, and the removal by girdling or killing of interfering trees of the less valuable species.

Seedling Improvements.—The seedlings of mahogany and cedar, which have a very characteristic appearance, are first located on the ground and marked by stakes from 4–6 ft. long, of which the top 6–9 in. is cleaned of bark. The labourer then cuts all the palms and small growth in the area allotted to him as a daily task. Small trees of up to 6–9 in. in diameter are felled and larger trees girdled. The large palms (chiefly Cohune, *Attalea Cohune* Morris) are bored to aid the attack of fungus and insects ; if they are giving too much shade they are felled. While the smaller trees are being felled the new stakes marking the position of seedlings are easily seen and avoided.

The slash is left on the ground to rot away. When this improvement has been done the area presents a very open appearance compared with the virgin " bush " and may now be termed " forest."

The seedlings appear to thrive with this drastic cleaning, provided the overhead canopy is broken sufficiently; and at the commencement of the growing season the leaders may put on 12–24 in. height growth in 2–3 weeks.

Re-improvement is done from time to time, usually at yearly intervals, with a provisional limit at present of three re-improvement operations, until a sufficient seedling stock has been obtained. This may be from thirty to several hundred seedlings per acre. The dense undergrowth appearing as a result of the opening out will then be encouraged to force up the seedlings, the heads of which will be kept free of interference. This latter stage is now being reached in the oldest Forest Reserve.

Seedling improvements are only done in the climax stages of the bush and the drastic cleaning reverses the succession to a stage more advantageous to the germination and growth of mahogany. Experiments have been started in various parts of the Colony under widely divergent conditions and the collected data will make a valuable addition to the knowledge of the silviculutre of mahogany.

(iii) In relation to the above improvement experiments, a small amount of research has been done on the shoot borers and leaf defoliators attacking mahogany and cedar seedlings. The caterpillars have been bred out and the moths identified by the Bureau of Entomology, United States Department of Agriculture, as follows:

Defoliator, *Egchiretes nominus* Dyar (Noctuidæ).

Shoot borer, *Hypsiphyla grandella* Zeller (Pyralidæ).

The latter is an allied species to the shoot borer of mahogany reported from Java in the *Mededeelingen*, No. 15, of the Forest Research Institute, Java. Field notes are being made in an attempt to combat attack.

It is noted, however, that in total shade the seedlings, which are in a stagnant condition, are not attacked, while the heaviest damage is done to seedlings without overhead cover, where growth is rapid and the crown tends to become branchy. Under the partial shade afforded by the seedling improvements, attacks vary apparently with climate and in the long dry season of 1926 were much worse than in the shorter dry period of this year.

(iv) With reference to the logging and extraction of mahogany and the secondary wood Banak (*Virola merendonis* Pittier), specimens of the ambrosia beetles attacking the wood in the log, and locally known as "pinworms," have been collected and forwarded to Dr. R. S. MacDougall of Edinburgh for identification. Three species were reported to be present in a collection made from one truck load of six Banak logs. Platypus and Xyleborus

spp. have been identified and the third species may or may not be entirely new. It may be the male of one of the above.

Several sprays have been tried under all conditions with varying degrees of success.

A Stanacola product, prepared by Standard Oil Company (the formula for which is not obtainable), was used several years ago on barked logs with great success when carefully done, but failed completely with the rougher and more "slip-shod" methods used in the bush.

A solution of carbolineum and kerosine tried in various proportions was an absolute failure, the logs carrying the largest amount of carbolineum appearing to be most affected.

The only safe measure at present appears to be to cut the wood in the dark of the moon and to get the logs into water with the least delay.

(3) *Balsa Woods. Pure crops and in relation to Mahogany*

After careful observation of the stands of Balsa woods found in the wamils (aftergrowth on abandoned shifting cultivation) of Stann Creek and Toledo, an attempt was made to grow pure crops of Polak (*Ochroma bicolor* Rowlee), Quam (*Schizolobium parahybum* (Vell.) Blake), and White Moho (*Belotia Campbellii* Sprague, and *Heliocarpus Donnell-Smithii* Rose), and small sample plots of about 1 acre each were made in the banana wamils of Middlesex, Stann Creek.

Quam seeds, being large, were dibbled in rows 3 ft. × 3 ft. apart and an exceptionally good germination was obtained. The seedlings made good growth in their first year, reaching an average height of 5–6 ft., with an average basal diameter of 1–2 in., but have made little height growth in their second year.

Polak and *Moho* seeds were dibbled at first with little success and then broadcast with most disappointing results. Fortunately wind-blown seed from the neighbouring wamil produced a patchy crop, chiefly of Polak, in which observations were made. In 1926, the second year, the stock was materially increased again by wind-blown seed. An average growth of 15 ft. with a diameter at breast height of 4 in. was noted in the first year.

A dense pure crop of Polak obtained naturally in 1926 on the abandoned cornpiece in one of the Reserves thrived for a year but is now dying off.

It was obvious from the first year's results that a good stock of healthy trees could be obtained more readily and more cheaply by seed blown from neighbouring trees, with artificial tending rather than by plantation work. The

growth of the seedlings obtained naturally appears to be much better than was made in the plantations, probably due, however, to the more open nature of the stand.

These plantations are now being used as shelter-crops for the experimental planting of mahogany seeds ; a most important purpose when it is understood that the present tend of mahogany seedling improvements is to produce artificially a wamil-like condition under a shelter wood of high bush species. Good germination was obtained and the seedlings are making good growth.

The average stock of Polak on 1,500 acres of banana wamils at Middlesex may be noted, but the growth is not good enough to render exploitation for pulp or other purposes feasible.

Average volume per acre	3,510 B.M. ft., or roughly 290 cu. ft.
Medium sized Polak had an average content of .	24 B.M. ft.
Large Polak up to 10 in. diameter had an average content of	97 B.M. ft.
Large Polak up to 15 in. diameter had an average content of	225 B.M. ft.

II. Other Forest Products

(1) *Chicle*

The following investigations were commenced in 1925 and are now being conducted on an Estate under Forest Management in the North of the Colony in connection with the production of Chicle, obtained from the latex of Sapodilla (*Achras Sapota* L.) and used in the manufacture of chewing gum.

(*a*) Forest meteorological observation.

(*b*) The distribution of Sapodilla and its association in relation to climate and soil.

(*c*) Study of the growth and yield.

(*d*) Experiments with various degrees of silvicultural improvement, for the purpose of securing development and natural reproduction under the most advantageous circumstances.

(*e*) Methods of artificial reproduction on areas inadequately stocked with parent trees.

(*f*) Study of methods of tapping.

(*g*) Calculation of tapping rotation.

Sample Sapodilla trees have been measured twice and the results, which may be regarded as the first accurate data regarding the growth of Sapodilla, are briefly summarised below.

Of the 97 trees and saplings measured in October 1925, 91 were re-measured in January 1927. One tree and three

saplings were found to have been broken by wind and one tree and one sapling could not be re-located.

The trees are all in the improved bush; they all have clean untapped stems, and hence are comparatively young; the average age is probably approximately 20–25 years. The average height to first branch is 26 ft. The greatest increment in girth, 1½ in. to 2 in., appears in trees averaging 30 ft. in height to the first branch, and of 24 in. girth and over, i.e. in those trees which are bearing their full height growth.

The saplings measured probably have an average age of 10–15 years; their average height to crown is approximately 18 ft.; the average girth is 8 in. In their case girth increment is small, averaging ¼ in.

The following statistics from the re-measurement are given with the object of forming some idea of the development of Sapodilla; the relation of active growth, as shown by girth increment, to the production of latex has yet to be established.

Average Development of Sapodilla

(Period between measurements, 15 months)

—	Girth increment.	
	On the best Broken Ridge soil	In high Acache.
	in.	in.
Trees 18 in. girth and over	7/8	3/4
Trees 18 in. girth	3/4	5/8
Saplings under 9 in. girth	1/4	—

The two plots of natural seedlings (*Achras Sapota*) in good Broken Ridge bush in the same estate enclosed in November, 1925, were examined and each numbered seedling carefully re-measured in January 1927. The period between measurement and re-measurement was in all cases 14 months. The age of the seedlings is now probably between 3 and 5 years.

Seedling Plot 1. In this plot a light cleaning was done in November 1924, but no cleaning has been made subsequently; the opening of the overhead canopy was carried out in the normal course of Sapodilla tree improvements. As a whole the seedlings were found to be vigorous and healthy, not much eaten by insects, and vastly better than the seedlings in Plot 2, where drastic cleaning was carried out.

Out of 25 original seedlings 21 were found and re-measured. The greatest individual increase in height growth was 21 in.; this seedling in November 1925 measured 19 in. to the tip of the leading shoot; in January 1927 it measured 40 in. The least individual increase was

2 in.; 50 per cent. of the seedlings showed increase in height of 12 in. and over. The average increase in height was 10½ in. The average height of the seedlings is now 20 in.

Seedling Plot 2. In this plot a light cleaning was made in November 1924 and a very thorough cleaning in November 1925; the latter appears to be the cause of generally poor height growth, and much loss of leaves and leading shoots through insect attack. The few seedlings which had shot up fairly well happen to have been surrounded by high growth on the edges of the plot.

Out of 62 original seedlings, 48 were found and re-measured. The greatest individual increase in height was 14½ in. and the least was 1 in. Only 10 per cent. show increase of 12 in. and over. The average increase in height was 6 in. The average height of seedlings is now 16 in.

Comparison of results in these two plots, which have similar soil and other conditions, seems to indicate that, provided the overhead canopy has been lightly opened, seedlings are best left to force their way up through the surrounding growth, with at most one light cleaning per year; this cleaning of surrounding growth within a radius of about 3 ft. of the seedlings leaves an open funnel for the seedling to shoot up in.

(2) *Silk Grass* (*Pita*), *Bromelia spp.*

A small experiment in hand-cleaning the leaves of silk grass for the fibre gave a yield of 2 oz. of fairly clean fibre, the average length of the strands being 2 yards. The cost of preparation was $1·73 (roughly 7*s*.). The experiment was discontinued.

III. Botanical Material

Specimens of all woody plants and trees are being collected, particular attention being paid to the larger trees and especially to the Sapotaceæ. Good work is being done in the clearing up of local names and a third revision of the check list of British Honduras trees has just been made by Professor Record of Yale.

CYPRUS

A Note on Flax

(Forwarded by the Acting Colonial Secretary)

Experimental lots of flax straw were laid out in November, 1926, in the following places: Zodia, Cholmetchik, Larnaca, and Nicosia. The Zodia lot was native straw, the Cholmetchik lot Belgian, the Larnaca and the Nicosia lots "J.W.S."

With the exception of the Zodia lot, and a very small percentage of that grown at Nicosia, all the trial lots failed. The cause was "black spot" disease, which attacked the plant during retting and weakened the fibre to such an extent as to render it similar to weak cotton, giving the fibre an unpleasant "dead" touch. The disease is caused by a fungus known as *Pleospora herbarum* Rabenh. and a related form *Alternaria tenuis* Nees. After prolonged correspondence with the Imperial Bureau of Mycology, the Imperial Bureau of Entomology, the Linen Research Institute, Lambeg, and the "Forschungsinstitut für Fasern," Sorau, it was established that "black spot" disease is very uncommon on flax; it is, however, known to have occurred on flax sent in 1922 from Kenya Colony.

The mycelium of the fungus is responsible for the dark colouration and "deadness" of the fibre; the black dots which develop on the epidermis and partly on the fibre being the fruiting bodies.

This fungus appears to be more virulent than the fungi commonly found on retting flax straw; with its appearance the *Mucor stolonifer* (*Rhizopus nigricans*), *Mucor plumbeus* and *Cladosporium* gradually disappeared; the two former were the first to appear and the *Cladosporium* superseded them in the second fortnight, to be superseded in turn by the *Pleospora* at the end of the fifth week.

The small percentage of the Nicosia crop which escaped the attack of the *Pleospora* was extraordinarily fine and silky, and of a beautiful silver-grey colour, showing to full advantage the fine quality of the "J.W.S." fibre.

The experimental lot in Zodia was raised from the ground before the retting was accomplished. It was scutched and produced a medium quality codilla or flax tow, which has been sold in the United Kingdom for about £65 per ton. The climate of Zodia was different from that of Nicosia in so far as there was less rain and more sunshine; also, the field on which the straw was laid out was free from decaying herbaceous stems of plants.

A second trial lot was laid out near the Department in March. The retting proceeded normally, the common retting fungi making their appearance in usual order, viz. *Rhizopus nigricans*, *Mucor plumbeus* (very lightly) and *Cladosporium*. No *Pleospora* was noticed, possibly because there was not sufficient time for it to infect the straw. The straw, moreover, was shifted frequently from one place to another, and in six weeks' time it was fully ready. The fibre so produced was of extraordinary strength and of a dark grey colour; hardly any tow was produced, nearly the full percentage obtained consisting of long fibre.

Samples produced in the second trial were sent to a firm in London and to certain Gruschwitz firms who are particularly interested in strong fibre for thread-making. The London firm reported as follows (June 22): "We certainly believe that dew-retting gives the best results and maintains the strength of the fibre. . . . We would, therefore, recommend you to continue the experiments in dew-retting and send us samples for report."

The straw in this instance was of the native variety.

A third trial lot was laid out in May, at Nicosia. As the rain was missing, and the dew not very regular, a few waterings were made. Notwithstanding this, no retting proper occurred at all. None of the above-mentioned fungi had made its appearance up to the end of June, the straw retaining its yellow-reddish colour.

The last experiment shows that summer retting is not feasible in Cyprus. This is common knowledge in Russia and other northern countries where only autumn retting (September–November) gives satisfactory results; flax retted in summer invariably gives a nasty, hardish, reddish fibre.

The three experiments, carried out at various times of the year, and with various kinds of straw, appear to show: (1) that, most important of all, the chief retting fungi are present in the Island; (2) that attacks by "black spot" disease may occur, but also may be avoided; and (3) that the most favourable time for retting is March–May.

The quality of the fibre produced in dew-retting depended on the nature of the flax; in the case of the "J.W.S." seed it was very fine and soft and lustrous; in the case of native seed it was hardish but extremely strong.

ABSTRACTS OF RECENTLY PUBLISHED LITERATURE ON AGRICULTURE AND FORESTRY

In this section a summary is given of the contents of the more important recently published papers and reports relating to tropical agriculture and forestry. It must be understood that the Imperial Institute accepts no responsibility for the opinions expressed in the papers and reports summarised.

Foodstuffs

Cocoa.—A detailed account of the disease known as "collar crack" of cocoa (*Armillaria mellea* (Vahl.) Fr.) by H. A. Dade, A.R.C.S., Government Mycologist, is published in *Bulletin* No. 5 (1927) of the *Gold Coast Department of Agriculture.*

The name " collar crack " was applied to the disease as being descriptive of its most evident and characteristic symptom. It was first reported in the Kpoeta district of Togoland in 1922, and was found to be due to an organism of the *Armillaria* species. In the Gold Coast, the attack is generally confined to small groups of trees, and once a tree is found to be attacked, the disease is so rapid that therapeutic treatment is of no avail.

Trees which have been attacked exhibit a number of longitudinal fissures extending up the trunk to a maximum height of 8 to 10 feet above the ground level. According to a Kew report, the disease is due to *Armillaria mellea* (Vahl.) Fr., an organism widespread throughout the world as a common saprophyte, and as a parasite of many forest and orchard trees as well as of smaller plants.

The organism apparently has the ability of attacking healthy trees. In the case of cocoa, infection is set up through the lateral roots, which are nearly always close to the surface. In each of the many cases examined by the author, infection was found to be due to actual contact of the host's roots with diseased roots or rotting wood, and not to the agency of rhizomorphs as is usually stated to be the case with *A. mellea.* Humidity appears to be the only environmental condition associated with intensity of attack ; altitude does not in itself appear to be a determining factor, as the disease was first discovered in the Gold Coast at an altitude of 2,700 feet, and later at 400 feet.

It has been suggested that the disease might be controlled by reducing humidity by cutlassing weeds, ventilating farms, and by drainage where necessary ; by eliminating diseased trees and material upon which the fungus can grow as a saprophyte ; and also by isolating infected ground by trenches. The treatment of diseased trees with various antiseptics has also been recommended. In the Gold Coast *Armillaria mellea* is scheduled as an " injurious pest " in the Plants (Injurious Pests) Ordinance of 1923.

Oils and Oil-seeds

Copra.—The improvement of the quality of Fiji copra is now engaging the attention of the authorities in that Island (*Fiji, Legislative Council*, *Paper, No.* 3, 1927). With a view to ascertaining how Fiji copra compares with that produced in other countries, samples were obtained from all the bulk stores in Suva and Levuka and analysed by the Government Chemist. Six samples from Suva were found to contain from 5·3 to 7·6 per cent.

of moisture and from 2·98 to 11·90 per cent. of free fatty acids (calculated as oleic acid). Eight samples from Levuka contained from 4·7 to 8·0 per cent. of moisture and from 5·23 to 19·15 per cent. of free fatty acids. A comparison of these results with similar figures for average commercial samples of copra from other sources shows that Fiji copra contains a much higher percentage of free fatty acids than do the other copras, with the exception of that from the South Seas in which case the acidity is approximately the same.

Fiji copra, as produced at present, is of lower grade than most of the copra offered for sale on the European market. The inferior quality is due largely to the percentage of free fatty acids which, besides being high, is liable to vary between very wide limits, with the result that buyers can never be sure of the quality of their purchase. The high acidity is due to inefficient drying and the small size of the pieces into which the kernels are cut. To improve the quality it is, therefore, recommended that the nut be cut into not more than four pieces and then well dried in the sun. When dried, the copra should be well packed and protected from rain and other causes of damage.

The Imperial Economic Committee has suggested that a copra bill, along the lines of that in force in Samoa, be enacted in Fiji. This suggestion is being followed, and the Superintendent of Agriculture recommends that two grades only should be recognised in the case of copra intended for export, namely, "Fiji First," for copra with 5 per cent. or less of free fatty acids and "F.A.Q." for that with from 5 to 10 per cent. The prohibition of the export of copra containing more than 10 per cent. of free fatty acids is advocated.

Oils, Fats and Waxes in the United States of America.—*Dept. Bull. No.* 769, *Dept. Agric., U.S.A.*, has been revised and recently published as *Dept. Bull. No.* 1475 (1927) under the title of "The Production and Utilisation of Fats, Fatty Oils and Waxes in the United States." After a brief introduction the general methods employed in the preparation of these materials are outlined. The main portion of the *Bulletin* is devoted to an account of the sources, methods of preparation and uses of the different edible and technical vegetable and animal oils, fats and waxes. In the case of cotton-seed oil, coconut oil, ground-nut oil and soy-bean oil, descriptions are given of the different grades established by the Inter-state Cotton Seed Crushers' Association. The last few pages contain

tables showing the quantities of oils and fats produced and consumed in the United States during the five years 1921–25; the quantities of these materials and of oil-producing seeds imported into the country, as well as the quantities of raw materials used in the production of oils.

Essential Oils

Citronella Oil.—An account of experiments in the cultivation of citronella in French Equatorial Africa, carried out by F. Raunier, is given in *La Parfumerie Moderne* (1927, **20**, 64). The author reviews the varieties which he has cultivated, compares conditions of climate, soil and methods of harvesting and distilling with those obtaining in Ceylon and Java, and points out differences in the yields and characters of the oils. The plants grown in the Cameroons furnished an annual yield of 30 to 35 tons of leaves per hectare, and the leaves gave 5·066 kilos. of oil per ton. Samples of oil obtained from plants cultivated in the Congo, Gaboon and Cameroons contained from 28·9 to 45·6 per cent. of geraniol, and 23·2 to 50·3 per cent. of citronellal.

Eucalyptus Oils.—A study is being made by A. R. Penfold of oils obtained from eucalyptus trees cultivated in Ashfield, New South Wales (*Journ. and Proc. Roy. Soc., New South Wales*, 1926, **60**, 104).

When *E. australiana*, which furnishes probably the best cineole oil for pharmaceutical purposes, is grown at Wyndham, New South Wales, it always yields an oil containing phellandrene in an amount sufficient to render it unsuitable for medicinal use. Distillers have therefore been compelled to abandon the distillation of the oil in this district. Oil distilled at Ashfield from trees grown from seed collected at Wyndham yielded, however, oil of normal character, free from phellandrene. It has been suggested that probably some constituent of the soil at Wyndham is responsible for the production of phellandrene.

Two samples of freshly-cut leaves and terminal branchlets of *E. Macarthuri* from trees grown at Ashfield, cut as for commercial purposes, yielded 0·50 and 0·74 per cent. of oil, containing 62 and 70 per cent., respectively of geranyl acetate, whereas two samples of leaves and branches collected at the same seasons from trees grown in other districts from the same batch of seedlings, gave only 0·20 and 0·26 per cent. of oil, containing respectively 75 and 67 per cent. of geranyl acetate. The increased

yield of oil from the trees cultivated at Ashfield is attributed to richer soil and greater accessibility to moisture.

Five distillations of leaves and terminal branches of *E. citriodora* yielded from 0·5 to 1·0 per cent. of oil containing from 90 to 98 per cent. of citronellal. The author has already published figures showing that the ordinary field material yields, on the average, about 0·75 per cent. of oil, whilst cultivated material yields from 1·0 to 1·5 per cent. The above yields from trees grown at Ashfield are lower than those obtained from Queensland trees. It is stated that the difference may be due to a particular race existing within the species, as a number of distillations made with material collected from aged trees growing in the western suburbs of Sydney in no case yielded less than 1·0 per cent. of oil (calculated on the fresh material), the greater proportion of yields being from 1·2 per cent. to 1·8 per cent., whilst the oils contained from 95 to 98 per cent. of citronellal.

Miscellaneous Oils.—Several other Australian essential oils have been examined by A. R. Penfold (*Journ. and Proc. Roy. Soc., New South Wales*, 1926, **60**, 73, 104, 331). *Eriostemon Coxii* Mueller is a shrub about 10 feet in height, found growing at an elevation of 3,500 feet at the sources of the Clyde River, southern district of New South Wales. The leaves possess a pleasant odour resembling that of passion fruit (*Passiflora edulis*). The leaves and terminal branchlets furnished 0·55 per cent. of oil, the principal constituents of which are *d*-*α*-pinene; butyl and amyl isovalerianates; geraniol, citronellol and darwinol (an alcohol, $C_{10}H_{18}O$, resembling geraniol), both free and in the form of esters; and a sesquiterpene, probably cadinene.

The leaves and terminal branches of *Phebalium dentatum* Smith, a shrub 15 to 20 feet high occurring plentifully in the Port Jackson district, yielded 0·21 per cent. of oil closely resembling in odour and composition the oil of *Eriostemon Coxii.*

Leptospermum lanigerum Smith, a tall plant widely distributed throughout New South Wales, Victoria, South Australia and Tasmania, appears to possess variable botanical characters. Leaves and terminal branches of two forms collected from Monga in New South Wales were examined separately by the author. The silver leaf type yielded 0·28 to 0·33 per cent. of oil, containing 60 to 75 per cent. of aromadendrene and eudesmene, 16 to 20 per cent. of *d*-*α*-pinene with small quantities of cineole, geraniol, geranyl formate and cinnamate, citral, an *iso*-valerianic acid ester, a sesquiterpene alcohol and unidenti-

fied phenolic substances, whereas the green leaf type yielded from 0·46 to 0·67 per cent. of oil, containing 40 to 60 per cent. of *d-a*-pinene, 40 to 45 per cent. of darwinol and its acetate, with small quantities of sesquiterpenes and sesquiterpene alcohols and unidentified phenolic substances.

The leaves and terminal branches of *Zieria macrophylla*, a plant having an average height of about 3 feet, obtained from Herrick, North East Tasmania, gave an average yield of 0·45 per cent. of a deep reddish-brown oil having an unpleasant odour due, apparently, to the presence of a low-boiling *iso*-valerianic ester together with amyl alcohol. The principal constituents were *d*-limonene (10 to 20 per cent.) and a new cyclic ketone, $C_{18}H_{30}O$ (50 to 60 per cent.), which has a pleasant odour of fresh cedarwood though slightly camphoraceous.

RUBBER

Rubber in Burma.—Large tracts of land suitable for the cultivation of rubber are available in the Tenasserim Division of Burma. With a view to directing attention to the possibilities of the country as a producer of rubber the Government of Burma have issued in the form of a pamphlet entitled *Rubber in Burma*, reprints of newspaper articles and notes and extracts from reports on the subject by Government and other officials.

According to the officiating Director of Agriculture, it is estimated that in the Tavoy and Mergui districts alone there are 120,000 acres suitable for the extension of rubber planting. This area comprises only the more level lands and gentler slopes, but in addition there are steeper lands which might possibly serve for planting schemes when the more eminently suitable sites have been taken up. The lands which have been pronounced suitable for rubber extension in the districts mentioned comprise blocks up to 6,500 acres or more in extent. Some of these are in close proximity to established areas. Although all the areas demarcated will grow rubber, some of them are more suitable than others, and the location, soil conditions, etc., of the areas regarded as the best are indicated. In the Mergui district there were 25,000 acres of planted rubber in 1926, whilst applications for rubber grants in the district during the preceding year were stated to cover over 41,000 acres. The yield of rubber from the existing estates is stated to be in some cases equal to anything found in Malaya, an average yield of 550 lb. per acre being recorded from two blocks on one estate.

Rubber from Budded Trees.—The results of an investigation on the latex and rubber from some budded trees and from their mother trees are given by O. de Vries and W. Spoon in *Archief voor de Rubbercultuur in Nederlandsch-Indië* (1927, **11**, 112). Six mother trees growing at the Economic Gardens at Buitenzorg were used in the experiments, two of which were planted in 1882 and the remainder in 1908. Buds were taken from the trees in 1918 and the budded trees controlled by means of their seeds in 1924 and 1925 ; only the results from those individuals which proved to be true to their clone are considered in the paper. The latex from the mother trees varied ; in some cases it was of normal composition and in others the rubber content was low and the ratio between the organic and the mineral substances in the serum unfavourable. The rubber from the trees also varied, showing normal properties in some cases, and being inferior in others. Almost without exception the latex and rubber from the budded trees showed the same characters as their mother trees.

Preparation of Ball-rubber in Java.—In view of the fact that "fine hard Para" rubber from Brazil is regarded by manufacturers as superior to "Plantation Para," attempts have been made from time to time on various estates in different countries to prepare a smoked ball-rubber after the Brazilian method. These experiments were carried out to a much larger extent in Java than anywhere else and a comprehensive survey of such experiments is given (in Dutch and in English) by O. de Vries and W. Spoon in *Archief voor de Rubbercultuur in Nederlandsch-Indië* (1927, **11**, 1). In some instances the preparation of ball-rubber was worked out on a large scale and it was found possible to apply the method in estate practice, a total of 120 tons being so prepared during the years 1919–1921. As the method of preparation showed no special advantages and as no regular demand for the product developed, the estates reverted to the usual methods of preparation.

A description is given in the paper of ball-rubber preparation and of the properties of the rubber so produced on different estates, as compared with the ordinary estate product and fine hard Para. A summary is given of the opinions of manufacturers on the Java ball-rubber, which shows that it was regarded as intermediate in quality between fine hard Para and ordinary plantation rubber.

Cortex Rot of Hevea in Uganda.—Experiments on the causation and control of a disease of Hevea in Uganda

are recorded by J. D. Snowden in *Circ. No.* 17, *Dept. Agric., Uganda*, 1926. The disease, which has been known in Uganda for several years and has become increasingly prevalent and more serious since tapping was resumed a few years ago, is found only on the tapped cortex. The first signs of its presence are depressed spots a short distance above the tapping cut. Affected parts are at first darker in colour than the normal renewal bark, but later they become covered with a white mycelium and spores of various fungi, forming a greyish-white mould over the surface which is visible some ten or twenty yards away. The cortex under the diseased spots rots away, leaving the wood, which is darkened and much discoloured, quite bare. If the disease is neglected it may lead to irregular renewal of the bark, making future tapping difficult, or allow the entry of borers which may kill the trees.

It was found that the following fungi were always associated with the disease: *Fusarium* spp. (including *F. udum* Butl.), *Cephalosporium* sp. and *Cladosporium* sp. Inoculation experiments demonstrated that *Fusarium udum* and *Cephalosporium* sp. will cause the disease, the *Cladosporium* apparently merely following after the other fungi have infected the tree. A species of *Sphæronema*, very similar to that which is stated to cause the mouldy rot of Hevea in Malaya (see this BULLETIN, 1926, **24**, 50), was later found on diseased trees, but it apparently only occurs on the exposed wood and is regarded by Mr. Snowden as a saprophyte.

The disease is most apparent on trees which have been badly injured on tapping. It is more prevalent during wet weather and in damp, low-lying situations; close planting and a dense growth of tall weeds are favourable to its spread.

Experiments have shown that the disease is cured by two applications of a 10 per cent. solution of Agrisol or Brunolinum Plantarium, with an interval of ten to fourteen days between the sprayings. An application of a 3 per cent. solution of the fungicide at fortnightly intervals during the period when conditions are favourable to the spread of the disease prevents re-infection. In addition to the application of fungicides the undergrowth should be cut down fairly frequently to allow a free current of air to circulate round the bases of the trees and, most important of all, the risk of serious infection should be prevented by avoiding injury to the tree when tapping.

FIBRES

Cotton

South Africa.—The *African Sugar and Cotton Journal* (May 1927, p.29) contains a review of the 1925–26 cotton crop of the Union of South Africa which has been published by the Division of Field and Animal Husbandry of the Department of Agriculture. The total crop amounted to 26,828,717 lb. of seed-cotton which furnished 8,152,559 lb. of cotton or 17,577 running bales. These figures are repeated below in comparison with the corresponding data for the years 1921–22 onwards :

	1921–22	1922–23	1923–24	1924–25	1925–26.
Seed-cotton lb	3,415,261	8,227,325	11,465,122	21,678,362	26,828,717
Ginned cotton lb	1,096,182	2,609,068	3,492,065	6,774,423	8,152,559
Running bales .	2,640	6,064	7,392	15,119	17,577
Statistical bales (500 lb.)	2,198	5,218	6,984	13,549	16,305

The following table shows the proportions of the crop produced in the different areas of the Union during the three years 1923–24 to 1925–26, the figures representing lb. of seed-cotton :

	1923–24	1924–25	1925–26
Natal and Zululand	6,374,601	8,278,681	12,307,848
Rustenburg Area (including Pretoria and Marico Districts) . .	543,846	2,489,842	3,863,484
Northern Transvaal (including Waterberg, Pietersburg and Zoutpansberg)	1,139,730	5,706,607	2,879,195
Eastern Transvaal (including Middleburg, Lydenburg and Barberton) .	2,379,541	4,142,090	4,731,179
Southern Transvaal (Pongola River area)	—	123,619	840,474
Swaziland	783,289	641,608	1,243,177
Cape Province	244,115	237,600	830,391
Bechuanaland and Orange Free State .	—	58,315	132,969

South African cotton is mostly about 1⅛ in. long ; the relative proportions of the different staples produced during the three years 1923–24 to 1925–26 is shown below :

	1923–24		1924–25		1925–26	
	Bales	Per cent	Bales	Per cent	Bales.	Per cent
1¼ inch and above .	8	—	42		65	⅓
1 3/16 inch . . .	89	1¼	315		169	1
Full 1⅛ inch . . .	1,169	16	3,005		575	3¼
Good 1⅛ inch . .	2,097	28¾	7,050		6,045	34⅓
1⅛ inch	2,273	31¼	3,072	20	6,041	34⅓
1 1/16 inch and below .	1,631	22½	1,635	10¾	4,682	26⅔
	7,267	100	15,119	100	17,577	100

It is estimated that in the 1926–27 season approximately 61,600 acres were planted, the areas in the various districts being: Natal and Zululand, 40,000 acres; Rustenburg area (including Pretoria and Marico Districts), 5,000 acres; Northern Transvaal area (including Waterberg, Pietersburg and Zoutpansberg Districts), 4,600 acres; Eastern Transvaal area (including Middelburg, Lydenburg and Barberton Districts), 3,000 acres; Vaal River area (Douglas District), 500 acres; Cape Province, 1,500 acres; Swaziland, 7,000 acres.

Owing to the uncertain weather conditions and the effect of the drought on the young plants, it was considered impossible to give an estimate of the 1926–27 crop, but it is anticipated that it will be smaller than that of the 1925–26 season.

Angular Leaf-spot in Uganda.—The occurrence of this disease in Uganda was suspected in 1924 and has now been confirmed by J. D. Snowden, Acting Mycologist, who has recorded his investigation in *Circ. No.* 17 (1926), *Dept. Agric., Uganda Protectorate.* This work proves beyond any doubt that the symptoms which have been observed are due to the organism *Bacterium malvacearum*, E.F.S. Shortly after the disease had been discovered a circular memorandum was forwarded to all the agricultural officers, together with specimens of the disease, in order that the distribution of the affection could be determined during the ensuing season. The disease has been found present in many parts of the Administrative Districts of Mengo, Busoga, Budama, Bugwere, Bugishu, Teso, Lango, Entebbe and Mubende, and there is no doubt that it is prevalent throughout the country. Control measures are suggested, and it is recommended that consideration should be given to the question of the production of varieties of cotton resistant to the disease.

Sisal Hemp

Gold Coast.—An account of the results obtained at the Government Sisal Plantation at Accra is given in *The Gold Coast; A Review of the Evidence of* 1920–1926 *and the Prospects of* 1927–1928, by the Governor, Sir F. G. Guggisberg, K.C.M.G., D.S.O.

During the year 1926, 468½ tons of fibre were baled as compared with 160 tons in 1925 and 56 tons in the previous year. The factory and plantation costs have gradually been reduced to between £15 and £16 per ton, the quality of the fibre has been well maintained, and new machines have been installed for brushing the fibre and baling it at

full length. The following statement of revenue and expenditure during 1926 is given :

		£ s. d.
Total Revenue (the December revenue being estimated)		14,877 0 5
Expenditure (actual) :	£ s. d.	
Plantation	8,272 15 6	
Interest on Capital . . .	2,123 17 10	
Depreciation on machinery . .	687 13 0	
		11,084 6 4

Although the plantation has served a useful purpose in showing that Sisal hemp can be profitably grown on the Accra plains, it is considered that insufficient progress has been made with the main object of the enterprise, namely, of inducing the farmers in the neighbourhood to undertake the cultivation. In due course, however, the energy and propaganda of the Agricultural Department will doubtless lead to success. Meanwhile the Government has decided to continue to work the plantation, as large profits are being made and the capital charges are being slowly paid off. The exports of Sisal hemp from the Gold Coast during the years 1925 and 1926 were 176 tons of value £6,995 and 456 tons of value £18,193 respectively.

Paper-making Materials

Umbrella Tree (*Musanga Smithii* R.Br.).—A monograph, consisting of a series of studies of the wood of the umbrella tree and its suitability for paper-making, reprinted from *L'Agronomie Coloniale* (see this BULLETIN, 1924, **22**, 230), has been published under the title of *Parasolier et Papier de Parasolier* (Paris : Librairie Émile Larose, 1926). The papers have been contributed by P. Ammann, M. Aribert, A. Bertin, F. Bretonnet, C. Chalot, G. Noachovitch, A. Thiriet and L. Vidal, and a preface to the whole has been written by Em. Prudhomme. The work consists of seventy-six pages and contains a large number of excellent diagrams, photographs and photomicrographs, as well as specimens of paper made from umbrella tree wood-pulp. Copies of the work are also obtainable which are printed entirely on umbrella tree paper.

TANNING MATERIALS

Urunday and Urunday Extract.—A survey of this forest product was presented by W. Vogel at the Congress of the Internationaler Verein der Leder-Industrie-Chemiker held in Vienna in October 1926 (*Collegium*, 1926, pp. 535–541).

Urunday occurs with quebracho in most parts of

South America where the latter is encountered, and, according to the author, should prove of material assistance in compensating for the present shortage of quebracho.

Three kinds of Urunday are mentioned in the article, Urunday pardo (*Astronium Balansæ* Engl., N.O. Anacardiaceæ), Urunday pichai (*Astronium* sp.), and Urunday blanco or Urunday nra (*Diplokeleba floribunda* Brown, N.O. Sapindaceæ), but for the manufacture of tannin extracts the first alone is of interest.

Urunday pardo attains a height of 15 to 20 metres and a diameter of 50 to 60 cms. It resembles quebracho colorado chequeño so closely that the one may easily be confused with the other. In general the trunk of Urunday is not quite so stout as that of quebracho, but it grows somewhat taller than the latter.

On analysis by the filter method the heartwood, sapwood and bark gave the following results:

	Heartwood. *Per cent.*	Sapwood. *Per cent*	Bark. *Per cent.*
Tannins	14·4	1·4	12·4
Soluble non-tannins	1·5	1·2	3·3
Insoluble matter	65·1	54·9	71·9
Moisture	19·0	42·5	12·4

The tannin content of the samples of heartwood examined varied between 11 and 16 per cent., but the number was too small to furnish an accurate average. This would, however, lie between 13 and 14 per cent., which is about two-thirds of that of quebracho wood. The Urunday bark contained about three times as much tannin as quebracho bark.

Natural and sulphited extracts prepared from Urunday wood gave on analysis results similar to those obtained with quebracho extract, except that the Urunday extracts contained much more mineral matter. One hundred kilos. of Urunday wood furnish about 20 kilos. of solid extract containing 63 to 65 per cent. of tannin, 6·1 to 7·2 per cent. of soluble non-tannins, and 5 to 8 per cent. of insoluble matter. The Urunday extracts occasionally met with in commerce contain slightly less tannin and more non-tannins than quebracho extracts, the ratio tans : non-tans, as regards the natural extracts, being 100 : 10 in the case of Urunday, and 100 : 7 in that of quebracho.

Urunday tannin belongs, like quebracho, to the catechol group, and the two cannot, at present, be differentiated by qualitative reactions. Urunday extracts, on the whole, colour the leather in a similar manner to quebracho extracts, except that the sulphited Urunday

extracts produce a darker-coloured leather than those of quebracho, and the leather prepared with Urunday extracts darkens more on exposure to light.

Urunday and quebracho possess similar speeds of penetration, but Urunday produces a leather of greater weight and firmness.

As to whether the extracts of Urunday and quebracho should be placed on the market separately or mixed together, the author states that from the tanner's point of view it would probably be preferable to have the individual extracts, but that the difference between the two extracts is so slight as to render this procedure scarcely worth while.

Forestry and Timbers

Afforestation in South Africa.—The *Report of the Forest Department of the Union of South Africa* for 1925–26 states that the area reafforested by the Department during the year under review was the largest annual planting ever accomplished in South Africa, the area being 15,276 acres, or 2,044 acres more than in the previous year. Towards this total the Midland Conservancy contributed the largest acreage, viz. 5,858 acres. Conifers constituted 85 per cent. of the plantings and sowings, the species concerned being *Pinus Pinaster*, *P. insignis* and *P. canariensis*; eucalypts, 14 per cent., and other species, 1 per cent. The Transvaal and Orange Free State Conservancy came next in order with 3,716 acres, 77 per cent. of which was placed under conifers (*Pinus patula*, *P. caribæa*, *P. tæda*, *P. longifolia* and *Cryptomeria japonica*), the remaining areas being chiefly under eucalypts. In Natal, the area afforested was 1,083 acres, of which the greater part is at Weza; for the whole Conservancy, conifers (*Pinus patula*, *P. longifolia*, *P. caribæa*, *Cryptomeria japonica* and *Cupressus lusitanica*) were planted to the extent of 85 per cent., eucalypts 13·5 per cent., other species (including oaks as firebelts) constituting the remainder. In the Western Conservancy, 1,781 acres were afforested chiefly with *Pinus Pinaster* and *P. canariensis*. The Eastern Conservancy had 1,607 acres planted, practically all species being coniferous. In the Transkeian Conservancy a small area of 511 acres was planted, wattles amounting to 58 per cent., conifers 37 per cent., and other species making up the residue. Of the total acreage for the Union an area of 12,718 acres, or 83 per cent., was afforested with conifers; 1,974 acres, or 13 per cent., with eucalypts, and 584 acres, or 4 per cent., with other species of which practically half consisted of wattles in the Transkei.

In connection with this work the observations made in the report on Forest Research are interesting. The Indian *Pinus longifolia* continues to show itself the most reliable pine for the drier conditions of eastern South Africa. Of the Australian conifers tried, it would appear to be established that *Araucaria Cunninghamii* will prove to be a very valuable tree for the mist-belt and sub-tropical localities. The interesting conifers of central Eastern Africa, *Juniperus procera* (the pencil cedar of Kenya and Tanganyika) and *Widdringtonia Whytei* (of Nyasaland) show considerable promise at a number of plantations in the Union. Experiments are also being carried out with the useful Californian pine, *Pinus lambertiana*. Of eucalypts hitherto little known in the Union, *E. Muelleriana* has grown exceptionally well, and seed has been widely distributed.

Reclamation of Drift Sands in South Africa.—The reclamation work carried out in the Western Conservancy of the Union of South Africa during the year 1925–26 (*Report of the Forest Department*) illustrates the varying utility of apparently promising species for binding the sand. The planting of marram grass (*Psamma arenaria*) at Strandfontein was quite successful, although a number of "blow outs" occurred. Waxberry (*Myrica* sp.) and the wattles, *Acacia cyclopis* and *A. saligna*, were sown over the planted marram, but the young acacia seedlings did not appear able to withstand the scorching effects of the sun and wind during the summer and large numbers succumbed. The waxberry seedlings, however, showed up well. Altogether, some 487 acres were reclaimed in the Union during the year mentioned, 423 acres being in the Western Conservancy.

Dusting with Insectides by Aeroplanes.—In view of the interest being taken in the possibilities of the use of aeroplanes for the distribution of insecticides, attention may be drawn to the results of experiments carried out in the Union of South Africa as recorded in the *Report of the Forest Department* for 1925–26. The eucalyptus snout-beetle (*Gonipterus scutellatus*) is the most serious tree pest in the Union at the present time, and no practical means of dealing with it has as yet been devised. The species most severely attacked are *Eucalyptus viminalis*, *E. globulus* and *E. Maideni*. A test of the value of aeroplane dusting —the first in the history of South Africa—was arranged by the Division of Entomology and carried out by the South African Air Force. An aeroplane was specially

adapted for the work and the dusting experiments were carried out on infested young stands of *E. globulus* and *E. viminalis*. Calcium arsenate was the insecticide employed.

The results obtained showed that the method was a success as regards the destruction of the pests, but the expense involved, and the necessity for repeated dustings at intervals to prevent re-infestation, together with the impracticability of reaching all remote plantations and shelter belts and the absence of a commercial organisation to undertake such work, indicated that practicable means of controlling the pest must be sought in other directions.

Economic Costs of Railway Sleepers in India.—*Indian Forest Bulletin, No.* 68 (*Economy Series*) (1926), deals from the economic point of view with the results of practical trials of the duration of life of railway sleepers made of various timbers, treated in various ways, in comparison with those composed of cast iron and steel.

Latterly, certain Indian railways have been buying steel sleepers on a large scale, but the conclusions reached by the authors of this publication show that, generally speaking, wooden sleepers are slightly more economical than metal ones. Moreover, the cost of wooden sleepers is likely to become less owing to the use of saw-mill machinery in place of hand-sawing in the jungle.

A number of less-known timbers have been subjected to experiment, and have been found, after suitable treatment, to be actually more economical than sal, deodar, teak or jarrah.

The supplies of many timbers likely to prove economically useful for sleepers are such as to preclude any question of their exhaustion. Those mentioned include the following: in Burma: gurjun (*Dipterocarpus* spp.); in Assam: hollong (*Dipterocarpus pilosus*), panisaj (*Terminalia myriocarpa*), makai (*Shorea assamica*), jarul (*Lagerstrœmia Flos-Reginæ*) and needle-wood (*Schima Wallichii*); in North India: chir (*Pinus longifolia*), blue pine (*Pinus excelsa*), spruce, and silver fir; in Madras and Bombay: *Mesua*, teak, laurel (*Terminalia tomentosa*), karani (*Cullenia excelsa*), pali (*Dichopsis elliptica*), and *Eugenia* spp.; in Central India and Bihar: sal, laurel, kusum (*Schleichera trijuga*), arjun (*Terminalia Arjuna*), padri (*Stereospermum chelenoides*), axle-wood (*Anogeissus latifolia*), and mohwa (*Bassia latifolia*).

Dogwood and Persimmon in the United States.—The flowering dogwood (*Cornus florida*) and persimmon (*Diospyros virginiana*) occur over large areas in the eastern part of

the United States, and their woods are among the most valuable of the minor timbers of that country. The particular combination of properties in each of these two woods (hardness, toughness, fineness of texture, smoothness in wear) renders them peculiarly valuable for the manufacture of certain articles, of which shuttles used for weaving are the most important.

The prospect of decreasing supplies of these woods, and their steadily rising prices, furnish a reason for a consideration in *Bull. No.* 1436 (1926), *U.S. Dept. Agric.*, of the question of conserving the trees and using the woods to the best advantage.

Textile manufacturers for the most part insist on shuttles made from wood absolutely free from defects, and this entails the discarding of a fairly considerable amount of wood in their production. The utilisation of such wood for making a number of other articles is considered, and at the same time it is pointed out that minor defects in the wood of which a shuttle is made need not affect its satisfactory operation. A factor which increases the cost of shuttles is the length of time for which the wood is commonly stored to ensure proper seasoning, necessitating the holding by manufacturers of excessive stocks. To avoid this, kiln-drying is advocated.

An unfortunate property of both dogwood and persimmon is the extent to which they are liable to alter in volume according to atmospheric conditions, a fact which is objectionable not only in shuttles but also in other articles, such as shoe lasts. The best way to saw the logs in order to minimise distortion on shrinking is indicated, and reference is made to the use of linseed oil to reduce the extent to which moisture is absorbed and lost by the finished shuttles. It is pointed out that a more resistant impregnating agent than linseed oil is to be desired. At the same time methods of treating other woods should be devised which would give them some of the properties of the woods under consideration, particularly that of retaining a smooth surface under wear, which is absolutely essential in shuttles for use in modern textile machinery.

The publication concludes with some notes on other woods which might possibly be used as substitutes for dogwood and persimmon. These are: blue beech (*Carpinus caroliniana*), hornbeam or ironwood (*Ostrya virginiana*), madroña (*Arbutus Menziesii*), Oregon myrtle (*Umbellularia californica*), Canyon live oak (*Quercus chrysolepsis*), Pacific dogwood (*Cornus Nuttallii*) and Pacific yew (*Taxus brevifolia*).

BIBLIOGRAPHY

Comprising the more important reports, articles, etc., on plant and animal products, contained in publications received in the Library of the Imperial Institute during the three months June–August 1927.

The publications issued by the Governments of the Colonies and Protectorates can be obtained from or through the Crown Agents for the Colonies, 4, Millbank, Westminster, S.W.1. Applications for Dominion and Indian Government publications may be made to the Offices of the High Commissioners or Agents-General in London.

Agriculture

General

Reports on the Work of Agricultural Research Institutes, 1925–26. *Agricultural Research Council Paper No.* 70. Pp. 106 (mimeographed), 13 × 8¼. (London: Agricultural Research Council, 1927.)

Fifteenth Report of the Board of Agriculture for Scotland, for the year ended December 31, 1926. Pp. 92, 9½ × 6¼. (Edinburgh: H.M. Stationery Office, 1927.) Price 1*s.* 6*d.*

Year-Book of the Department of Agriculture, Ceylon, 1927. Pp. 66, 9¾ × 7¼. (Peradeniya: Department of Agriculture, 1927.)

Guide to the Botanic Gardens, Henaratgoda, Ceylon. By K. J. A. Sylva. Pp. 24, 8½ × 5½. (Colombo: Government Printer, 1927.) Price R.1.

Annual Reports of the Heads of Divisions, Department of Agriculture, F.M.S. and S.S., 1926. *Mal. Agric. Journ.* (1927, **15**, 130–205.)

Review of Agricultural Operations in India, 1925–26. By D. Clouston. Pp. 152, 10 × 7. (Calcutta: Government of India Central Publication Branch, 1927.) Price Rs.2–6 (4*s.* 3*d.*).

Estimates of Area and Yield of Principal Crops in India, 1925–26. *Dept. Comm. Intell. and Stat., India.* Pp. 49, 13 × 8¼. (Calcutta: Government of India Central Publication Branch, 1927.) Price As.12 or 1*s.* 3*d.*

Annual Report of the Department of Agriculture, Bengal, for the Year 1925–26. Pp. 31 + cclxxiii, 9¾ × 6¼. (Calcutta: Bengal Secretariat Book Depot, 1927.) Price Rs.6, As.2 (10*s.*).

Report of the Agricultural Department, Bihar and Orissa, 1925–26. Pp. 94, 9½ × 6. (Patna: Superintendent, Government Printing, 1927.) Price Rs.2.

Annual Report of the Department of Agriculture in the Bombay Presidency, for the Year 1925–26. Pp. 230, 9½ × 6. (Bombay: Superintendent Government Printing, 1927.) Price R.1, As. 12 (3*s.*).

Report on the Operations of the Department of Agriculture, Punjab, for the Year ending June 30, 1926. Part I. Pp. 85, 9½ × 6. (Lahore: Superintendent, Government Printing, 1927.) Price Rs.3, As.6 (4*s.* 6*d.*).

Annual Report, Department of Agriculture, Forests and Fisheries, Palestine, 1926. Pp. 71, 13 × 8¼. (Jerusalem: Director of Agriculture and Forests, 1927.) Price P.T.10.

Annual Report on the Department of Agriculture, Seychelles, for the Year 1926. Pp. 7, 13 × 8¼. (Victoria, Mahé: Government Printer, 1927.)

Annual Report of the Agricultural Department, Nigeria, for the Year 1926. Pp. 20, 13 × 8¼. (Lagos: Government Printer, 1927.)

Report of the Secretary, Department of Agriculture, Southern Rhodesia, for the Year 1926. Pp. 42 + 10, 13 × 8¼. (Salisbury: Government Printer, 1927.)

Report of the Secretary, Department of Agriculture, Union of South Africa, for the Year ended June 30, 1926. *Annual Departmental*

Reports, No. 6, pp. 198–234. (Pretoria: Government Printing Office, 1927.) Price 5*s.*

Economic Plants of South Africa. By E. P. Phillips. *Reprint from the Official Year Book* No. 8, Chapter I, Section 10. Pp. 6, 9½ × 6. (Pretoria: Government Printing Office, 1927.)

Report of the Minister of Lands and Forests of the Province of Ontario for the Year ending October 31, 1926. Pp. 185, 9¾ × 6½. (Toronto: King's Printer, 1927.)

Report on the Agricultural Department, Dominica, 1925–26. Pp. 36, 13 × 8¼. (Trinidad. Imperial Commissioner of Agriculture for the West Indies, 1927.) Price 6*d.*

Guide to the Royal Botanic Gardens, Trinidad. By R. O. Williams. Pp. 30 + vi, 8½ × 5½. (Port-of-Spain: Government Printing Office, 1927.) Price 1*s.*

Notes on a Visit to the Netherlands Indies, and the Federated Malay States. Part II.—Sugar, "Snow" Rubber, Cinchona, Nipa Palm, Budding and Grafting. By G. G. Auchinleck. *Bull. No.* 8, *Dept. Agric., Gold Coast.* Pp. 36, 9¾ × 6. (Accra: Government Printer, 1927.)

Jaarboek van het Departement van Landbouw, Nijverheid en Handel in Nederlandsch-Indië, 1926. Pp. xxviii + 237, 9½ × 6¾. (Weltevreden: Landsdrukkerij, 1927.) Price fl.3.25.

Irrigation in the Empire. Memorandum and Questionnaire. By B. A. Keen. Pp. 8, 9¾ × 7¼. (London: Empire Marketing Board, 1927.)

Irrigation (*cont.*). By A. R. C. Clifton. *Journ. Dept. Agric., W. Austr.* (1927, **4**, 2nd. Ser., 257–272).

The Use of Water in Irrigation. *Agric. Dept. Circ., No.* 47, *Brit. Columbia.* Pp. 19, 8¾ × 6 (Victoria, B.C.: King's Printer, 1927.)

The Percolation of Water in Soils and its Relation to Irrigation. By E. S. West. *Agric. Gaz., N.S.W.* (1927, **38**, 389–399).

Watermetingen bij Padi Gadoe en Polowidjo in de Residentie Soerabaja, oostmoesson 1923, 1924, en 1925; door G. J. Vink en W.A. Horst. Benevens een Wiskundige Analyse der Resultaten, door E. de Vries. *Korte Med. van de Afdeeling Landbouw No.* 4, *Dept. Landb. Ned. Ind.* Pp 46, 9½ × 6. (Buitenzorg: Archipel Drukkerij.) With Summary in English.

Cover Crops and the Possibilities of Utilising Indigenous Plants. By T. H. Holland. *Trop. Agric., Ceylon* (1927, **68**, 263–268).

Weeds of South Africa. Part IV. By K. A. Landsdell. *Reprint No.* 30, 1926, *Dept. Agric., Un. S. Afr.* Pp. 35, 9½ × 6. (Pretoria: Government Printing Office, 1927.) Price 3*d.*

Noxious Weeds in Southern Rhodesia. By F. Eyles. *Rhod. Agric. Journ.* (1927, **24**, 551–558).

"Natural Control" of Weeds and Insects by Fungi. By G. H. Cunningham. *New Zealand Journ. Agric.* (1927, **34**, 244–251).

Prickly Pear. Botanical Description, History, and the Problem the Plant Presents. (*Cont.*). By G. P. Darnell-Smith. *Agric. Gaz., N.S.W.* (1927, **38**, 383–388).

The Water Hyacinth and Eradication Work in the Southern Province during 1926. By W. C. Lester-Smith. *Year-Book, Dept. Agric., Ceylon,* 1927. Pp. 39–40.

Water Hyacinth Eradication. By W. C. Lester-Smith. *Trop. Agric., Ceylon* (1927, **68**, 336–339).

The Soil

Chemical Aspects of Soil Cultivation. By. E. M. Crowther. *Emp. Cotton Growing Rev.* (1927, **4**, 206–216).

Examination of the Soils of the Sudan. By A. F. Joseph. Pp. 7, 9½ × 6½. (Rome: International Society of Soil Science, 1926.)

Recent Studies in Heavy Alkaline Soils. By A. F. Joseph. Pp. 5, 9½ × 6½. (Rome: International Society of Soil Science, 1926.)

The Reclamation of Salt Land at "Daliak," York, Western Australia. By G. L. Sutton. *Journ. Dept. Agric., W. Austr.* (1927, **4**, 2nd Ser., 199-201).

Fertilisers and Crops for Marsh Soils. By A. R. Whitson, A. R. Albert and O. R. Zeasman. *Bull.* 392, *Wisconsin Agric. Exper. Sta.* Pp. 36, 9½ × 6. (Madison, Wisconsin: State University, 1927.)

The Residual Values of Feeding Stuffs and Fertilisers. *Journ. Min. Agric.* (1927, **34**, 401-411).

Report on the Work on the Decomposition of Green and Organic Manures. By A. W. R. Joachim. *Trop. Agric., Ceylon* (1927, **68**, 258-262).

La Question des Assolements et des Fumures vertes aux Antilles. By A. Kopp. *Bull Gén. No.* 2, *Sta. Agron., Guadeloupe.* Pp. 24, 9½ × 6. (Guadeloupe: Station Agronomique, 1927.)

Insect Pests—General

Annual Report of the Government Entomologist, Department of Agriculture, F.M.S. and S.S., for 1926. *Mal. Agric. Journ.* (1927, **15**, 168-173).

Army Worms, Cut Worms and Web Worms. By L. J. Newman. *Journ. Dept. Agric., W. Austr.* (1927, **4**, 2nd Ser, 227-239).

The Codling Moth, *Cydia* (*Carpocapsa*) *pomonella* Linn. Its Life History and Control. By C. French, Jun. and G. T. Levick. *Journ. Dept. Agric., Victoria* (1927, **25**, 351-358).

Codling Moth Traps. By A. Spuler. *Bull. No.* 214, *Washington Agric. Exper. Sta.* Pp. 12, 9½ × 6. (Pullman, Washington: State College, 1927).

The Introduction of *Cryptolaemus montrouzieri* Muls. into Egypt. By W. J Hall *Bull. Entom. Res.* (1927, **17**, 385-392).

The European Earwig: Its Habits and Control. Some Recent Experimental Work in New Zealand. By J. Muggeridge. *New Zeal. Journ. Agric.* (1927, **34**, 395-401).

The San José Scale (*Aspidiotus perniciosus* Comstock). By H. Jarvis. *Queensland Agric. Journ.* (1927, **27**, 513-517).

Records of Australian Thysanoptera (Thrips.). By A. A. Girault. *Queensland Agric. Journ.* (1927, **27**, 403-406).

Oil Sprays. Their Use and Effectiveness in Control of Fruit-tree Leaf-roller, Oyster-shell Scale, and Blister-mite (Under Interior Conditions of B C). By H. H. Evans. *Circ. No.* 68 (*New Hort. Ser.*), *Dept. Agric.* (*Hort. Branch*), *Brit. Columbia.* Pp. 11, 8¾ × 6. (Victoria, B.C.: Horticultural Branch, Department of Agriculture, 1927.)

Fungoid Pests—General

Annual Report of the Mycologist, Department of Agriculture, F.M S. and S S., for 1926. *Mal. Agric. Journ.* (1927, **15**, 152-159).

Root Diseases of Economic Crops. [Correspondence by C. H. Gadd and W. Small.] *Trop. Agric., Ceylon* (1927, **68**, 363-381).

The Classification of Plant Viruses. By J. Johnson. *Res. Bull.* 76, *Wisconsin Agric. Exper. Sta.* Pp. 16, 9½ × 6. (Madison, Wisconsin: State University, 1927.)

Grey Blight of Tea and Coconut. A Comparative Study. By L. S. Bertus. *Annals, Roy. Bot. Gard., Peradeniya* (1927, **10**, 197-241).

Notes on Some Physiological Conditions affecting the Parasitism

of *Rhizoctonia solani* Kühn. By M. Park. *Year-Book, Dept. Agric., Ceylon*, 1927, pp. 47–48.

Beverages

Nouveaux documents sur le Caféier Chari (*Coffea excelsa*). By A. Chevalier. *Rev. Bot. Appl. et d'Agric. Col.* (1926, **6**, 667–675; 765–772).

Agronomische Beschrijving van de Koffiecultuur in de Zuidelijke Toradjalanden. By B. H. Paerels. *Med. van de Afdeeling Landbouw No.* 11, *Dept. Landb., Ned. Ind.* Pp. 86, 10½ × 7. (Weltevreden: Landsdrukkerij, 1927.) Price fl.3·50.

Desinfectie van door Bessenboeboek (*Stephanoderes Hampei* Ferr.) aangetast Koffiezaad. By J. G. J. A. Maas and K. B. Boedijn. *Med. Alg. Proefsta., A.V.R.O.S., Alg. Ser. No.* 29. Pp. 16, 10½ × 7½. (Nimef—Malang.)

The Tea Research Institute of Ceylon. Bulletin No. 1, Annual Report for the Year 1926. Pp. 29, 9¾ × 6. (Kandy: Tea Research Institute of Ceylon, 1927.)

The Manufacture of Tea in North-east India. By P. H. Carpenter and C. J. Harrison. Pp. 42, 9¾ × 7½. (Calcutta: Indian Tea Association, 1927.)

Verpakking, Waterbepaling en Veiling van Thee. By J. J. B. Deuss. *Med. Proefsta. voor Thee No. XCIX, Dept. Landb., Ned.-Ind.* Pp. 57, 10½ × 7½. (Batavia: Drukkerijen Ruygrok & Co., 1927.)

Some Notes on Tea Tortrix (*Homona Coffearia* Nietn.) By J. C. Hutson. *Year-Book, Dept. Agric., Ceylon*, 1927, pp. 11–18.

A Review of the Present Situation Regarding Tea Tortrix in Ceylon. By S. Stuart Light. *Trop. Agric., Ceylon* (1927, **68**, 349–362).

A Preliminary Note on the Distribution of the Ceylon Tea Calotermes. By F. P. Jepson. *Year-Book, Dept. Agric., Ceylon*, 1927, pp. 19–21.

Cereals

Covered Smut of Barley and its Control. By J. C. Neill. *New Zeal. Journ. Agric.* (1927, **34**, 304–308).

Storage of Maize in Coastal Districts. (*Cont.*). By H. Wenholz. *Agric. Gaz., N.S.W.* (1927, **38**, 367–373).

Variability in the Linkage of Two Seed Characters of Maize. By G. N. Collins and J. H. Kempton. *Dept. Bull. No.* 1468, *U.S. Dept. Agric.* Pp. 64, 9¼ × 6. (Washington: Government Printing Office, 1927.) Price 10 cents.

Spread and Infestation by the European Corn Borer during 1926. By L. H. Worthley and D. J. Coffrey. *Misc. Circ. No.* 104, *U.S. Dept. Agric.* Pp. 11, 9¼ × 6. (Washington: Government Printing Office, 1927.) Price 5 cents.

The European Corn Borer. Life History in New Hampshire. 1923–1926. *Tech. Bull.* 33, *New Hampshire Agric. Exper. Sta.* Pp. 39, 9¼ × 6. (Durham, New Hampshire: State University, 1927.)

The European Corn Borer. The Relation of the Larvæ to Submergence. By M. F. Crowell. *Tech. Bull.* 30, *New Hampshire Agric. Exper. Sta.* Pp. 20, 9¼ × 6. (Durham, New Hampshire: State University, 1926.)

A Sclerotial Disease of Maize (*Zea Mays* L.) due to *Rhizoctonia Solani* Kühn. By L. S. Bertus. *Year-Book, Dept. Agric., Ceylon*, 1927, pp. 44–46.

Oat-Smut and its Control. Survey and Experimental Work, Season 1926–27. By J. C. Neill. *New Zealand Journ. Agric.* (1927, **34**, 237–243).

Rice Trade in the Far East. By J. A. LeClerc. *Trade Promotion*

Series, No. 46, *Bur. For. and Dom. Comm., U.S. Dept. Comm.* Pp. 73, 9½ × 6. (Washington: Government Printing Office, 1927.) Price 10 cents.

Autour de la riziculture indochinoise. (*Cont.*). By P. Vieillard. *Agron. Col.* (1927, **16**, No. 112, pp. 113–121).

The Selection of Pure-line Strains of Paddy, their Testing and Distribution. By L. Lord. *Trop. Agric., Ceylon* (1927, **68**, 309–318).

La Selezione del Riso. By R. Chiappelli. *Giorn. di Risicoltura* (1927, **17**, 91–99).

Grain Sorghums. By W. T. Richardson. *Journ. Dept. Agric., W. Austr.* (1927, **4**, 2nd Ser., 217–218).

Wheat-Growing in the South-west and Riverina. By E. S. Clayton. *Farmers' Bull. No.* 160, *Dept. Agric., N.S.W.* Pp. 48, 9½ × 6. (Sydney: Government Printer, 1927.) Price 9*d.*

Amélioration de la culture du Blé en Tunisie. By F. Bœuf. *Rev. Bot. Appl. et d'Agric. Col.* (1926, **6**, 657–666; 757–765).

Seed Pickling. Summary of Trials conducted at Roseworthy College. *Journ. Dept. Agric., S. Austr.* (1927, **30**, 1128–1132).

Wheat Pickling Methods. By H. A. Mullett. *Journ. Dept. Agric., Victoria* (1927, **25**, 290–293).

Sugar

Annual Report of the British Guiana Sugar Planters' Experiment Station, October 1, 1925, to September 30, 1926. *Journ. Bd. Agric., Brit. Guiana* (1927, **20**, 143–182).

Remarques sur la Culture de la Canne à Sucre en Polder à Java. By Y. Henry. *Bull. Econ. Indochine* (1927, **30**, Nouv. Sér., No. 184, pp. 63–68).

Fiji Disease of Sugar Cane in the Maryborough District, Queensland. By E. J. F. Wood. *Queensland Agric. Journ.* (1927, **27**, 388–393).

Root Crops

A Preliminary Report on Tapioca as a Catch-Crop with Oil Palms. By J. Lambourne. *Mal. Agric. Journ.* (1927, **15**, 104–113).

Mosaic and Leaf Roll of Potatoes. By W. M. Carne. *Journ. Dept. Agric., W. Austr.* (1927, **4**, 2nd Ser., 322–329).

The Sweet Potato Weevil (*Cylas formicarius* F.). By C. P. Vander Merwe. *Bull. No.* 14, *Dept. Agric., Un. S. Afr.* Pp. 10, 9½ × 6. (Pretoria: Government Printing Office, 1927.)

Les Diospyros comestibles. By L. Trabut. *Rev. Bot. Appl. et d'Agric. Col.* (1926, **6**, 541–547; 675–678).

Fruits

Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol, 1926. Pp. 148, 9½ × 6. (University of Bristol, 1927.)

Sub-tropical Fruit Culture. Achievement and Possibilities in the Auckland District. By W. H. Rice. *New Zeal. Journ. Agric.* (1927, **34**, 323–333).

Essentials to Successful Fruit Culture in Arizona. By F. J. Crider. *Bull. No.* 117, *Arizona Agric. Exper. Sta.* Pp. 59, 9½ × 6. (Tucson, Arizona: State University, 1926.)

Orchard Irrigation. By S. Fortier. *Farmers' Bull. No.* 1518, *U.S. Dept. Agric.* Pp. 27, 9½ × 6. (Washington: Government Printing Office, 1927.) Price 5 cents.

Preserving Fruits and Vegetables in the Home. By Ethel W. Hamilton. *Bull. No.* 77—*New Series, Dept. Agric., Canada.* Pp. 46, 9½ × 6½. (Ottawa: Minister of Agriculture, 1927.)

Extent and Causes of Rejections of Boxed Apples from the State of Washington, Seasons 1922 to 1925. By R. R. Pailthorp and J. W. Park. *Dept. Circ.* 413, *U.S. Dept. Agric.* Pp. 15, 9¼ × 6. (Washington: Government Printing Office, 1927.)

Arsenical Spray Residue and its Removal from Apples. By F. D. Heald, J. R. Neller, F. L. Overley and H. J. Dana. *Bull. No.* 213, *Washington Agric. Exper. Sta.* Pp. 56, 9¼ × 6. (Pullman, Washington: State College, 1927.)

Der Bananenbau in Florida. By J. C. Th. Uphof. *Tropenpflanzer* (1927, **30**, 196–201).

La Culture des Agrumes aux États-Unis. By J. C. Th. Uphof. *Rev. Bot. Appl. et d'Agric. Col.* (1926, **6**, 679–687; 772–781).

Grape Fruit. By R. O. Williams. *Proc. Agric. Soc. Trinidad* (1927, **27**, 195–214).

Valencia Late Oranges. Cool Storage Experiments. By G. B. Tindale *Journ. Dept. Agric., Victoria* (1927, **25**, 276–279).

Effect of Spraying with Fungicides on the Keeping Quality of Florida Citrus Fruits. By H. R. Fulton and J. J. Bowman. *Dept. Circ.* 409, *U.S. Dept. Agric.* Pp. 13, 9¼ × 6. (Washington: Government Printing Office, 1927) Price 5 cents.

The Control of Mosambi (*Citrus aurantium*) Gummosis. By M. N. Kamat. *Agric. Journ. India* (1927, **22**, 176–179).

Les Champignons de la Gommose des Citrus et de la pourriture des fruits. By J. Dufrénoy. *Rev. Bot. Appl. et d'Agric. Col.* (1926, **6**, 747–754).

Citrus Melanose and its Control. By J. R. Winston, J. J. Bowman and W. J. Bach. *Dept. Bull. No.* 1474, *U.S Dept. Agric.* Pp. 62, 9¼ × 6. (Washington: Government Printing Office, 1927.) Price 20 cents.

Produits secondaires retirés des Limes acides, des Citrons et des Bergamotes. By M. Fontaine. *Rev. Bot. Appl. et d'Agric. Col.* (1926, **6**, 601–613).

Propagation of Date Palms from Offshoots. By D. W. Albert. *Bull. No.* 119, *Arizona Agric. Exper. Sta.* Pp. 24, 9¼ × 6. (Tucson, Arizona. State University, 1926.)

The Fig Industry in Asia Minor. Notes of a Visit in 1925. By G. S. Cheema. *Bull. No.* 131 *of* 1926, *Dept. Agric., Bombay.* Pp 7, 9¼ × 6. (Bombay: Superintendent Government Printing, 1927) Price As.4, P 6, or 6*d*.

Peach Brown Rot and Scab. By J. W. Roberts and J. C. Dunegan. *Farmers' Bull. No.* 1527, *U.S Dept. Agric.* Pp. 14, 9¼ × 6. (Washington: Government Printing Office, 1927.)

Lithiasis and Bitter Pit of Pears. By W. M. Carne. *Journ. Dept. Agric, W. Austr.* (1927, **4**, 2nd Ser., 202–206).

Experiments on the Control of the Plum Curculio, Brown Rot, and Scab, attacking the Peach in Georgia. By O. I. Snapp, C. H. Allen, J. W. Roberts, J. C. Dunegan and J. H. Pressley. *Dept. Bull. No.* 1482, *U.S. Dept. Agric.* Pp. 32, 9¼ × 6. (Washington: Government Printing Office, 1927.)

La Noix du Brésil. By O. Ogden Pierrot. *Bull. Matières Grasses, Inst. Col., Marseille* (1927, Nos. 3–4, pp. 81–93).

Spices

The Fungi associated with disease in Vanilla. By T. Petch and C. Ragunathan. *Annals, Roy. Bot. Gard., Peradeniya* (1927, **10**, 181–196).

Fodders and Forage Crops

Forage Crops and their Culture in Northern Nebraska and the Dakotas. By S. Garver. *Farmers' Bull. No.* 1511, *U.S. Dept. Agric.*

Pp. 45, 9½ × 6. (Washington: Government Printing Office, 1927.) Price 10 cents.

Herbage Seed Production in New Zealand: I.—White Clover; II.—Red Clover and Lucerne; III.—Cocksfoot. By R. G. Stapledon. *Journ. Min. Agric.* (1927, **34**, 239–246; 328–334; 411–418).

Fodder Conservation for Wheat and Sheep Farmers. By E. S. Clayton. *Agric. Gaz., N.S.W.* (1927, **38**, 359–364).

Dry Season Safeguards for the Grazier. By N. A. R. Pollock. *Queensland Agric. Journ.* (1927, **27**, 410–429).

Permanent Pastures. By M. E. McCollam. *Bull. No.* 211, *Washington Agric. Exper. Sta.* Pp. 56, 9½ × 6. (Pullman, Washington: State College, 1927.)

The Grassland Conference at Cambridge. By A. B. Bruce. *Journ. Min. Agric.* (1927, **34**, 201–212).

The Grasslands of New Zealand. Regrassing Experiments on Deteriorated Hill Country in Whangamomona County. II. Studies on How Best to Win Back Secondary-growth Country. By E. Bruce Levy. *New Zeal. Journ. Agric.* (1927, **34**, 361–375).

Liming and Phosphate Top-Dressing Experiments on Pasture in Canterbury, New Zealand, 1924–25–26. By A. W. Hudson. *New Zealand Journ. Agric.* (1927, **34**, 252–262).

Liming of Pastures. Initial Results of Experiments in Auckland. By T. H. Patterson and J. W. Woodcock. *New Zeal. Journ. Agric.* (1927, **34**, 389–394).

The Mineral Constituents of Ceylon's Fodder Grasses. By A. W. R. Joachim. *Trop. Agric., Ceylon* (1927, **68**, 269–271).

Silos and Silage. By M. Edelman, J. B. Osborn, A. E. Romyn and P. B. Aird. *Bull. No.* 7, *Dept. Agric*, *Un. S. Afr.* Pp. 46, 9½ × 6. (Pretoria Government Printing Office, 1927.) Price 6*d.*

Silage Experiments on Shisham Leaves. By P. E. Lander and Bhai Balwant Singh. *Journ. Centr. Bur. Animal Husbandry and Dairying, India* (1927, **1**, 33).

Results from Feeding Silage in Western Australia By G. K. Baron-Hay. *Journ. Dept. Agric*, *W. Austr.* (1927, **4**, 2nd Ser., 287–297).

Observations on Subterranean Clover. By W. Davies. *Journ. Min. Agric.* (1927, **34**, 455–468).

Couch Grass (*Cynodon dactylis*) By W. M. Carne, A. B. Adams and C. A. Gardner. *Journ. Dept. Agric., W. Austr.* (1927, **4**, 2nd Ser., 219–221).

The Control of the Alfalfa Weevil By G. I. Reeves. *Farmers' Bull. No.* 1528, *U.S. Dept. Agric.* Pp. 22, 9½ × 6. (Washington: Government Printing Office, 1927.)

King Island Melilot (*Melilotus indica*). By W. M. Carne, C. A. Gardner and A. B. Adams. *Journ. Dept. Agric., W. Austr.* (1927, **4**, 2nd Ser, 196–198).

Digestibility of Teff-hay for Sheep. By J. C. Ross and A. M. Bosman *Sci. Bull. No.* 57, *Dept. Agric., Un. S. Afr.* Pp. 24, 9½ × 6. (Pretoria: Government Printing Office, 1927.) Price 3*d.*

The Life History of Timothy. By M. W. Evans. *Dept. Bull. No* 1450, *U.S. Dept. Agric.* Pp. 55, 9½ × 6. (Washington: Government Printing Office, 1927.) Price 25 cents.

Oils and Oil Seeds

Oléagineux et Huileries en Afrique Occidentale Française et Nigéria. By G. Vignat. *Bull. Matières Grasses, Inst. Col., Marseille* (1927, No. 2, pp. 48–58).

Oleos Vegetaes Brasileiros. Nogueira de Iguape (*Aleurites moluccana* = *A. triloba*). By Enrico Teixeira. *Ministerio da Agricultura,*

Industria e Commercio, Serviço de Informaçoes. Pp. 8, 9¼ × 6¼. (Rio de Janeiro: Government Printing Office, 1927.)

An American Palm Oil Industry (*Attalea Cohune*). By H. Wadell. *Oil and Fat Industries* (1927, **4**, 217–224).

Notes on some Pests and Diseases of Coconuts in the North-Western Division of Ceylon. By C. N. E. J. de Mel. *Year-Book, Dept. Agric., Ceylon*, 1927, pp. 22–24.

Leaf-break Disease of Coconuts. By C. Ragunathan. *Year-Book, Dept. Agric., Ceylon*, 1927, pp. 25–26.

Les Stations expérimentales de l'Arachide et du Palmier à Huile en A. O. F. Rapport par M. Fr. de Roux. *Bull. Matières Grasses, Inst. Col., Marseille* (1927, No. 6, pp. 149–163).

Contributions à la Sélection des Arachides à Madagascar. By J. Delpon. *Bull. Matières Grasses, Inst. Col., Marseille* (1927, Nos. 7–8–9, pp. 177–198).

A Sclerotial Disease of Ground-nut caused by *Sclerotium Rolfsii* Sacc. By L. S. Bertus. *Year-Book, Dept. Agric., Ceylon*, 1927, pp. 41–43.

Oil Content of Flaxseed, with Comparisons of Tests for Determining Oil Content. By D. A. Coleman and H. C. Fellows. *Dept. Bull. No.* 1471, *U.S. Dept. Agric.* Pp. 34, 9¼ × 6. (Washington: Government Printing Office, 1927.) Price 10 cents.

Notes on a Visit to the Netherlands Indies and the Federated Malay States. Part I.—The Plantation Oil-Palm Industry in the East. By G. G. Auchinleck. *Bull. No.* 8, *Dept. Agric., Gold Coast.* Pp. 36, 9¼ × 6. (Accra: Government Printer, 1927)

L'Augmentation de la production du Palmier à huile en A. O. F. By M. de Verville. *Bull. Matières Grasses, Inst. Col., Marseille* (1927, No. 2, pp. 37–42).

Hastening the Germination of Oil Palm Seeds. By J. W. Milsum. *Mal. Agric. Journ.* (1927, **15**, 82–84).

Concours Spécial pour la Culture des Oliviers en 1926 en Tunisie. *Bull. Matières Grasses, Inst. Col, Marseille* (1927, Nos. 3–4, pp. 99–105).

L'Industrie des Pépins de Raisins. By J. Bonnet. *Bull. Matières Grasses, Inst. Col, Marseille* (1927, No. 6, pp. 168–171).

Soy Beans. Culture and Varieties. By W. J. Moore. *Farmers' Bull. No.* 1520, *U.S. Dept. Agric.* Pp. 33, 9¼ × 6. (Washington: Government Printing Office, 1927.) Price 5 cents.

Essential Oils

Les Huiles essentielles extraites des Plantes de l'Espagne. By C. Renaudet *Parfumerie Moderne* (1927, **19**, 175–181).

Citronelles. By P. Jeancard. *Parfumerie Moderne* (1927, **19**, 166–171).

Le Géranium rosat. By C. Chalot. *Parfumerie Moderne* (1927, **19**, 136–139).

L'Ylang-ylang (*Cananga odorata* Hook. f. et Thomson). By C. Chalot. *Parfumerie Moderne* (1927, **19**, 163–164).

La Culture des Plantes à Parfum dans les Colonies Françaises. L'Ylang-ylang. By C. Chalot. *Agron. Col.* (1927, **16**, No. 112, pp. 105–112).

Fibres

Le Chiendent des Brossiers. By E. François. *Bull. Ag. Gén. des Col.* (1927, **20**, 233–237).

Growing Flax in Kansas. By H. H. Laude and W. E. Grimes. *Circ.* 133, *Kansas Agric. Exper. Sta.* Pp. 10, 9¼ × 6. (Manhattan, Kansas: State Agricultural College, 1927.)

Versuche über Ertragssteigerung bei Flachs durch Klimawechsel. By G. Bredemann. *Faserforschung* (1927, **6**, 51–72).

Wie lässt sich ein möglichst gleichmässiges Flachsstroh erzielen. By E. Schilling. *Faserforschung* (1927, **6**, 73–85).

Kapok. By R. O. Bishop and Gunn Lay Teik. *Mal. Agric. Journ.* (1927, **15**, 97–103).

Sur la Roselle (*Hibiscus Sabdariffa altissima*). By L. Koch. *Rev. Bot. Appl. et d'Agric. Col.* (1926, **6**, 754–757).

Rosella, *Hibiscus sabdariffa* Perrott. By A. Langer. *Tropenpflanzer* (1927, **30**, 183–191).

Some Wool Characters and their Inheritance. By C. B. Davenport and E. G. Ritzman. *Tech. Bull. No.* 31, *New Hampshire Agric. Exper. Sta.* Pp. 58, 9½ × 6. (Durham, New Hampshire: State University, 1926.)

Wool from Rabbits. By W. King-Wilson. *Journ. Min. Agric.* (1927, **34**, 361–364).

Cotton

Official Report of the International Cotton Congress held in Egypt, 1927, by the International Federation of Master Cotton Spinners' and Manufacturers' Associations. Pp. 263, 9½ × 6. (Manchester, 1927.)

Cotton Cultivation in the Hambantota District. By G. Harbord. *Year-Book, Dept. Agric., Ceylon*, 1927, pp. 31–32.

Progress in the Development of Cotton and other Crops in the Hambantota District. By G. Harbord. *Trop. Agric., Ceylon* (1927, **68**, 319–322).

Annual Report of the Indian Central Cotton Committee, Bombay, 1926. Pp. 169, 9¾ × 7. (Bombay: The Times Press, 1926.) Price Rs.2.

Studies in Gujarat Cottons, Part IV. Hybrids between Broach-deshi and Goghari Varieties of *Gossypium herbaceum*. By Maganlal L. Patel and S. J. Patel. *Mem. Dept. Agric. India, Bot. Ser.* (1927, **14**, 131–176).

Technological Reports on Standard Indian Cottons, 1923–26. By A. J. Turner. *Bull. No.* 7, *Tech. Ser. No.* 3, *Indian Central Cotton Committee Technological Laboratory.* Pp. 95, 13 × 8½. (Bombay: The Times Press, 1927.)

The Improvement of Cotton in Southern Rhodesia. By C. J. Lewin. *Emp. Cotton Growing Rev* (1927, **4**, 224–236).

The Classing of Queensland Cotton Crops, 1919–26. By L. L. Gudge. *Queensland Agric. Journ* (1927, **27**, 518–524).

The Entomological Problems of Queensland Cotton Growing. By E. Ballard. *Emp Cotton Growing Rev* (1927, **4**, 196–205).

Growth, Bud-Shedding and Flower Production in Egyptian Cotton. By M. A. Bailey and T. Trought. *Bull. No.* 65, *Tech. and Sci Serv., Min. Agric, Egypt.* Pp. 40, 10¾ × 7½. (Cairo: Government Press, 1927.) Price P T.5.

Cotonniers Malgaches. By B. P. S. Hochreutiner. *Rev. Bot. Appl. et d'Agric. Col.* (1926, **6**, 744–747).

Cotton Varieties for South-east Missouri. By B. M. King. *Bull.* 249, *Missouri Agric. Exper. Sta.* Pp. 8, 9½ × 6. (Columbia, Missouri: College of Agriculture, 1927.)

Cotton-spacing Experiments at Greenville, Texas. By M. C. McNamara. *Dept. Bull. No.* 1473, *U.S. Dept. Agric.* Pp. 48, 9½ × 6. (Washington: Government Printing Office, 1927.) Price 15 cents.

Community Production of Acala Cotton in the Coachella Valley of California. By H. G. McKeever. *Dept. Bull. No.* 1467, *U.S. Dept. Agric.* Pp. 47, 9½ × 6. (Washington: Government Printing Office, 1927.) Price 15 cents.

Sea-Island and Meade Cotton in the South-eastern States. By O. F. Cook and C. B. Doyle. *Dept. Circ.* 414, *U.S. Dept. Agric.* Pp. 19, 9¼ × 6. (Washington: Government Printing Office, 1927.) Price 5 cents.

Development of Flowers and Bolls of Pima and Acala Cotton in Relation to Branching. By H. F. Loomis. *Dept. Bull. No.* 1365, *U.S. Dept. Agric.* Pp. 27, 9¼ × 6. (Washington: Government Printing Office, 1927.) Price 5 cents.

Manufacturing Tests of Cotton of the White Grades of the Universal Standards for American Cotton. By H. C. Willis. *Dept. Bull. No.* 1488, *U.S. Dept. Agric.* Pp. 29, 9¼ × 6. (Washington: Government Printing Office, 1927.) Price 10 cents.

Inheritance of the Number of Boll Locks in Cotton and their Relation to Yield. By R. K. Kulkarni. *Agric. Journ. India* (1927, **22**, 192–200).

Cotton Classing. By L. L. Gudge. *Queensland Agric. Journ.* (1927, **27**, 525–529).

Investigations on Raw Cotton. Deterioration of Cotton during Damp Storage. By A. C. Burns. *Bull. No.* 71, *Tech. and Sci. Serv., Min. Agric., Egypt.* Pp. 92, 10¾ × 7¼. (Cairo: Government Press, 1927.) Price P.T.10.

Paper-Making Materials

Esparto zu Zellstoff und Kunstseide. By E. Belani. *Faserforschung* (1927, **6**, 98–102).

The Suitability of American Woods for Paper Pulp. By S. D. Wells and J. D. Rue. *Dept. Bull. No.* 1485, *U.S. Dept. Agric.* Pp. 10, 9¼ × 6. (Washington: Government Printing Office, 1927.) Price 20 cents.

Rubber

À propos de la Culture de l'Hévéa à Sumatra. By Y. Henry. *Bull. Econ. Indochine* (1927, **30**, Nouv. Sér., No. 184, pp. 77–81).

Dry Rubber Content of Hevea Latex from Trees in Clean Weeded Areas and in Areas Under Fern Growth. By F. G. Spring. *Mal. Agric. Journ.* (1927, **15**, 78–81).

Jelutong. By B. J. Eaton, C. D. V. Georgi and Gunn Lay Teik. *Mal. Agric. Journ.* (1927, **15**, 65–77).

Tobacco

The Growing of Tobacco as a Non-irrigated Crop on the Experiment Station, Jaffna. By N. Senathi Raja. *Year-Book, Dept. Agric., Ceylon,* 1927, pp. 27–29.

The Handling, Grading and Baling of Cured Virginia Tobacco. By D. D. Brown. *Rhodesia Agric. Journ.* (1927, **24**, 507–519).

Tobacco Baling Boxes. By B. G. Gundry. *Rhodesia Agric. Journ.* (1927, **24**, 567–571).

The Tobacco Budworm and its Control in the Georgia and Florida Tobacco-growing Region. By A. C. Morgan and F. S. Chamberlin. *Farmers' Bull. No.* 1531, *U.S. Dept. Agric.* Pp. 9, 9¼ × 6. (Washington: Government Printing Office, 1927.) Price 5 cents.

Nadere gegevens over bestrijding van Veldschimmel (*Oidium* sp.) in de Vorstenlanden (3de publicatie). By A. d'Angremond. *Med. No.* 56, *Proefsta. voor Vorstenlandsche Tabak.* Pp. 48, 10¼ × 7¼.

A Rapid and Accurate Means of Estimating Nicotine in Tobacco and Tobacco Extracts. By R. R. le Geyt Worsley. *Bull. No.* 73, *Tech. and Sci. Serv., Min. Agric., Egypt.* Pp. 5, 10¾ × 7¼. (Cairo: Government Press, 1927.) Price P.T.2.

Drugs

The Variability of the Camphor Tree in Formosa. By F. N. Howes. *Kew Bull. No.* 4, 1927, pp. 157–164.

Cinchona einst und jetzt. By Ch. Böhringer. *Tropenpflanzer* (1927, **30**, 177–182).

Forestry

General

Seventh Annual Report of the Forestry Commissioners, United Kingdom, for the Year ending September 30, 1926. Pp. 45, 9¾ × 6¼. (London: H.M. Stationery Office, 1927.) Price 1*s.*

Report on Forest Administration in the Andamans for the Year 1925–26. Pp. 76, 9¾ × 6¼. (Calcutta; Government of India Central Publication Branch, 1927.) Price Rs 4, As.8 (7*s.* 6*d.*).

Annual Forest Administration Report of the Bombay Presidency including Sind for the Year 1925–26. Pp. 233, 9¾ × 6. (Bombay: Superintendent Government Printing, 1927.) Price Rs.5, As.9 (9*s.* 3*d.*).

Progress Report on Forest Administration in the Punjab for the Year 1925–26. Pp. 37 + xcv, 9¾ × 6¼. (Lahore: Superintendent Government Printing, 1926.) Price Rs 5, As.8 (7*s.* 4*d*).

Annual Report on the Forest Department, Mauritius, for 1926. Pp. 12, 13 × 8¼.

Annual Report on the Forest Administration of Nigeria for the Year 1926. Pp. 28, 13 × 8¼. (Lagos: Government Printer, 1927.)

Annual Report of the Forest Department, Union of South Africa, for the Year ended March 31, 1926. *Annual Departmental Reports*, No. 6, pp. 321–352. (Pretoria: Government Printing Office, 1927.) Price 5*s.*

Report of the Director of Forestry, Canada, for the Fiscal Year ended March 31, 1926. Pp. 32, 9¾ × 6¼. (Ottawa: King's Printer, 1927)

Administration Report of the Conservator of Forests, Trinidad and Tobago, for the Year 1926. *Council Paper No.* 47 *of* 1927. Pp. 19, 13 × 8¼. (Port-of-Spain: Government Printer, 1927.) Price 1*s.* 6*d.*

Le Reboisement à Madagascar. By E. François. *Rev. Bot. Appl. et d'Agric. Col.* (1926, **6**, 737–744.)

Cedar. *Tree Pamphlet No.* 10, *Forest Service, Canada.* Pp. 7, 8¾ × 6 (Ottawa: Director of Forestry, 1926)

Western Cedar *Tree Pamphlet No* 11, *Forest Service, Canada.* Pp 6, 8¾ × 6. (Ottawa: Director of Forestry, 1926)

Sitka Spruce. *Tree Pamphlet No* 12, *Forest Service, Canada.* Pp. 6, 8¾ × 6. (Ottawa: Director of Forestry, 1926)

The Natural Replacement of Blight-killed Chestnut. By C. F. Korstian and P. W. Stickel. *Misc. Circ. No.* 100, *U.S. Dept. Agric.* Pp. 15, 9¼ × 6. (Washington: Government Printing Office, 1927.) Price 5 cents.

Timbers

Building Timbers of Queensland. By C. J. J. Watson. *Queensland Agric. Journ.* (1927, **27**, 450–456).

Anatomical Characters and Identification of the Important Woods of the Japanese Empire. By Ryozo Kanehira. Pp. 297 + 11 + 7, with 30 plates of photo-micrographs, 10¼ × 7¼. (Taihoku, Formosa: Government Research Institute, Department of Forestry, 1926.) [In Japanese.]

The Growth of the Wood of Ash (*Fraxinus excelsior* L. and *F. oxycarpa* Willd.) and Douglas Fir (*Pseudotsuga Douglasii* Carr.) By L. Chalk. *Quart. Journ. Forestry* (1927, **21**, 102–123).

Le Bois de Buis et ses succédanés. By L. Hédin. *Rev. Bot. Appl. et d'Agric. Col.* (1926, **6**, 593–597; 687–701).

Tanning Materials

Le Gambir: sa culture, son exploitation. By M. Fontaine. *Rev. Bot. Appl. et d'Agric. Col.* (1926, **6**, 419–429)

Valeur, comme Matière tannante de l'Écorce de "Nghien" du Tonkin (*Pentace tonkinensis* A. Chev.). By F. Heim de Balsac, A. Deforge and H. Heim de Balsac. *Bull. Ag. Gén. des Col.* (1927, **20**, 238–246).

Studio sulle Galle della *Pistacia atlantica* Desf. della Libia. By G. A. Bravo. *Boll. Uffic. R. Staz. Sperim. per l'Industria delle Pelli e delle Materie concianti, Napoli-Torino* (1927, **5**, 204–211).

Use of Sulphite Cellulose Extract as a Tanning Material. By E. L. Wallace and R. C. Bowker. *Tech. Paper No.* 339, *Bur. Standards, U.S Dept. Commerce.* Pp. 13, 10 × 7. (Washington: Government Printing Office, 1927.) Price 30 cents.

Gums and Resins

Indian Lac Association for Research. Comprehensive Report covering the activities of the Association from its inception in August, 1921, down to March 31, 1926. Pp. 29, 7¼ × 4¾. (Calcutta Thacker's Directories, Ltd)

Indian Lac Association for Research Report of the Committee from April 1, 1926, to March 31, 1927. Pp. 16, 9¾ × 6¼. (Calcutta: Star Printing Works, 1927)

Le Stick-Lac au Cambodge. By E. Martin de Flacourt. *Bull. Econ. Indochine* (1927, **30**, Nouv. Sér., No. 184, pp 115–126).

Some Physical Constants of Kauri Gum By P W Burbidge and W. A. Macky. *New Zeal. Journ. Sci. and Tech.* (1927, **9**, 2–3).

NOTICES OF RECENT LITERATURE

Books for review should be addressed to "The Editor, Bulletin of the Imperial Institute, South Kensington, London, S.W.7."

East Africa, A New Dominion: A Crucial Experiment in Tropical Development and its Significance to the British Empire. By Major Archibald Church, D.S.O., M.C. Pp. 315, 8¾ × 5¾. (London: H. F. & G. Witherby, 1927.) Price 18*s*.

In 1924 the British Government despatched to East Africa a Commission of Enquiry consisting of the Hon. W. Ormsby-Gore, Mr. F. C. Linfield and the author of this volume, together with Mr. J. A. Calder of the Colonial Office, their task being to carry out an impartial survey of the conditions in Kenya, Uganda, Tanganyika, Nyasaland and Northern Rhodesia, and to report to the Secretary of State for the Colonies on the measures which appeared desirable for the co-ordination of policy and the stimulation of economic development in these five countries. The

present work sets out the personal observations and opinions of its author, and may be regarded as complementary to the official report of the Commission which was issued in 1925. The book can be strongly recommended to all readers interested in the development of British East Africa as an extremely well presented and suggestive account of the territories concerned. Major Church has evidently exercised great care and accuracy in recording his impressions, and, while paying due tribute to the great work already accomplished by administrators and settlers, has indicated directions in which future activities might be employed with special advantage.

Major Church's opinions on the social and political questions involved may not meet with the approval of every reader of this interesting volume, but many probably will agree with his views that Englishmen " are presented with abundant opportunities in East Africa for building up a new civilisation in which black, white, and brown races will co-operate " and that in this great work " the crude materialism of the last century must be replaced by the newer idealism which animates the finest spirits of our age."

L'Élevage du Ver à Soie. By P. Braemer. Pp. 96, $8\frac{1}{2} \times 5\frac{1}{2}$. (Hanoi : Imprimerie d'Extrême-Orient, 1926.)

This little book, which appears to form a very useful guide to the raising of silkworms, was written for the benefit of the sericulturists in French Indo-China. The author states that since the war the price of mulberry cocoons in the Colony has greatly increased, the filatures often paying now twice as much for the cocoons. The raising of the worms thus offers prospects of considerable profit to local cultivators if the cocoons are of good quality, but the author finds that many engaging in the industry are unacquainted with the methods necessary for satisfactory results. He has, therefore, prepared this handbook which in a simple manner gives practical directions for the successful carrying out of all the operations involved. There are five parts to the book. The first deals with the planning and construction of the magnaneries or huts in which the feeding of the worms is carried out. Much depends upon the proper planning and management of these structures, and the subject is carefully considered by the author. Questions relating to the choice of the silkworm eggs for cultivation are dealt with in the second part. The next section covers a wider field and is concerned with the treatment of the eggs and the raising of

the worms from them ; the measures required to enable the worms to spin their cocoons to best advantage ; and the stifling of the cocoons and their subsequent storage. The methods described throughout these sections are simple and involve the use of no elaborate or expensive apparatus. The fourth part is concerned with the principal diseases of the silkworm and measures which should be taken to avoid them ; while the concluding section of the book gives a useful account of raising mulberry for sericultural purposes. The book is illustrated with a number of useful line drawings and, although written primarily from the point of view of conditions obtaining in Indo-China, would doubtless be of value to those engaging in silk-raising in other countries.

ARTIFICIAL SILK. ITS MANUFACTURE AND USES. By Thomas Woodhouse, F.T.I. Pp. xiii + 137, $8\frac{1}{2} \times 5\frac{1}{2}$. (London : Sir Isaac Pitman and Sons, Ltd., 1927.) Price 5s.

This little book achieves its object to provide for the general public and for those engaged in the production and distribution of artificial silk products a concise account of the processes involved in the manufacturing industry. The author, who is well known as the translator of Foltzer's standard work on artificial silk, has given in less than 140 pages a sufficiently complete and very interesting story of the main features of the industry from the manufacture of the cellulose from the raw materials, through the making of the yarns and the subsequent processes of winding, warping, sizing and beaming, to the weaving and knitting of the finished fabrics and other goods. A short, clear account is given of the four processes of artificial silk manufacture which have reached commercial importance (namely, the nitrocellulose, cuprammonium, viscose and cellulose acetate processes) and reference is also made to the interesting cellulose zinc chloride process of Wynne and Powell which, however, is not yet extensively employed. These methods are briefly described, and a special chapter is subsequently devoted to a fuller account of the manufacture of viscose which is by far the most important of the artificial silks now produced. The author has usefully included a chapter on the preparation of wood pulp in which, while not betraying any trade secrets, he has explained some of the special characters required in a pulp intended for artificial silk as contrasted with paper and other pulp manufactures. Such a pulp must be carefully bleached, preferably by an electrolytic bleach (e.g. sodium hypochlorite), and it is essential that

the pulp should be as uniform as possible in composition; this involves the removal of resin and all other undesirable substances with a minimum amount of damage to the cellulose of the pulp. Over sixty illustrations assist to make this volume a very useful handbook.

Les Concasseurs à Noix de Palme. By G. Passelègue. Pp. xiii + 162, 10 × 6½. (Paris: Librairie Émile Larose, 1927.)

This volume is a reprint in book-form of a series of articles on palm-nut cracking machines which appeared recently in *L'Agronomie Coloniale*. A preface to the book has been written by M. Max Ringelmann, Director of La Station d'Essais de Machines, and an introduction by M. Ed. Prudhomme, Director of L'Institut National d'Agronomie Coloniale.

In order to ascertain which type of cracking machine is the most suitable for use in the palm areas of French West Africa, twelve machines of English, French and German make, and representing the different types of machines, were chosen and their efficiency determined. In this book will be found a description of the machines tested and the result of the experimental trials from which one is able to judge the merits of the respective machines. The last chapter of the book deals with machines for the mechanical separation of the shells from the kernels by both the wet and the dry methods. The book is well illustrated with a large number of text figures and plates. Reference to many of the machines mentioned has been made in this Bulletin (1926, **24**, 223).

Principles of Soil Microbiology. By Selman A. Waksman. Pp. xxviii + 897, 9 × 6. (London: Baillière, Tindall & Cox, 1927.) Price 45*s*.

In this book the author, who is Associate Professor of Soil Biology at Rutgers University, and Microbiologist of the New Jersey Agricultural Experiment Stations, has made a comprehensive survey of the available information relating to the micro-organisms of the soil, their characters and identification, their biological processes and chemical activities, and the rôles that they play in relation to soil economy.

Numerous references to original papers are given, and there is a classified list of books which would constitute an excellent reference library for students and investigators. The book is designed as an introduction to further research and a help to workers in allied sciences rather

than as an ordinary textbook, and it should be of considerable value to all who are concerned with the scientific side of agriculture and with problems of soil fertility.

Principles and Practice of Mosquito Control. By John F. Marshall, M.A., F.L.S., F.E.S., Director of the British Mosquito Control Institute. Pp. viii + 39, 8¾ × 5½. With 53 original illustrations. (British Mosquito Control Institute, Hayling Island, Hampshire.) Price 2*s*. 6*d*.

The British Mosquito Control Institute, which was incorporated in February, 1927, owes its inception to the success of the work which was initiated in 1920 to deal with the nuisance caused by mosquitoes in Hayling Island. The present handbook describes the scope and work of the Institute, and gives an account of the various types of mosquitoes met with in this country and the methods used for controlling them.

In addition to affording the only opportunity available in this country for the practical study of the working details of a mosquito control scheme in actual and continuous operation, the Institute is equipped for carrying on research and providing instruction in all branches of mosquito investigation. It is also able to undertake the inspection of mosquito infested areas and to advise upon possible means of dealing with them.

The Institute is in the position to supply, for educational or research purposes, living or mounted specimens of British mosquitoes in the different stages of their life history, as well as stereoscopic and other photographs, lantern slides and diagrams, illustrating the characteristics of various species and the methods of controlling them.

Up to the present, the Institute has had to rely almost exclusively upon voluntary contributions, either in the form of donations or of membership subscriptions. It is to be hoped that sufficient funds will be forthcoming from annual subscribers or other sources to enable the Institute to carry on its work efficiently, and possibly to extend its operations in the near future.

Physico-Chemical Geology. By R. H. Rastall, Sc.D., F.G.S. Pp. vii + 248, 8¾ × 5½. (London: Edward Arnold & Co., 1927.) Price 15*s*.

In his preface the author states that this book is an attempt to give in a connected form some account of the application of modern theories of physical chemistry to geological problems. It is not intended for beginners in

geology, since an acquaintance with the general principles of the science, as set forth in any elementary textbook, as well as some knowledge of mineralogy, is assumed. It is fully recognised as being incomplete, but this is almost a necessity of the case, if the book is to be kept within any reasonable compass.

The subject is covered in a dozen chapters. The first deals with the principle of equilibrium in geology, this being followed by chapters on fusion and solidification, isomorphism, and polymorphism and inversions, which relate to mineralogy rather than geology. Chapters 5 to 7 deal with igneous rocks and metamorphism, the latter term being used in its usual restricted sense, although the chapter on metamorphism includes an account of low-temperature metasomatism as exemplified by silicification and phosphatisation. Chapters 8 and 9 deal with rock weathering and salt deposits, the latter including carbonates with an account of dolomitisation. Chapter 10 on ore deposits and chapter 11 on refractories and abrasives have a strong economic flavour, and include a section on glass sands. A final chapter gives a brief account of colloids in geology, and there is a useful index.

Eruptive Rocks. Their Genesis, Composition, Classification, and their Relation to Ore-deposits, with a Chapter on Meteorites. By S. J. Shand, D.Sc., Ph.D., F.G.S. Pp. xx + 360, $8\frac{1}{2} \times 5\frac{1}{2}$. (London: Thomas Murby & Co.; New York: D. Van Nostrand Company, 1927.) Price 20s.

The author of this stimulating work states in the preface that it is the outcome of three wishes. First, to clean up the jungle of rock names; second, to make petrology intelligible to people like physicists and chemists, who like to do their thinking in quantitative terms; third, to bring theory and practice together, and to show that the miner and petrologist have need of each other's help.

The first five chapters deal with igneous rocks, their fixed constituents, the fugitive constituents of the magma, the magma and its walls and the freezing of the magma. Chapters 6 and 7 discuss the classification of eruptive rocks and set forth a system of petrography based on quantitative considerations. The author declares that the day will come when no description of a rock will be considered satisfactory which does not include a quantitative statement of its mineralogical constitution. It is upon this and not upon chemical analysis that classification should be based. He divides igneous rocks into three groups, viz.: oversaturated, saturated, and under-

saturated, and in chapters 7 to 14 inclusive, he describes these groups of rocks. Chapter 15 deals briefly with meteorites, and there is a final chapter on eruptive ore deposits. References to authors are given at the end of each chapter, and a useful index of subjects and localities is provided. The book is printed on good paper and is furnished with a frontispiece and 43 text-figures.

THE LOCATION OF MINERAL FIELDS. By M. H. Haddock, F.G.S., A.M.I.Min.E. Pp. vii + 295, 7½ × 5. (London: Crosby Lockwood and Son, 1926.) Price 9*s*. 6*d*.

This book, written by an expert on his subject, should be of the greatest assistance to geologists and mining engineers engaged on all kinds of mineral survey work, and should appeal particularly to those with a slight mathematical bent.

It commences with discussions and solutions, both trigonometrical and geometrical, of all kinds of problems connected with dip, depth and thickness of strata. Then follows a chapter on contouring, and the instruments used for it, illustrated by some of the author's own work on the Western Front during the Great War. Further sections deal with outcrop work and mineral mapping; borehole surveying and its problems, with descriptions of various modern methods and apparatus used; and faulting and folding of strata, with excellent stereographic illustrations by the author, of strike, dip, diagonal and rotational faults and methods for obtaining complete fault data.

An important chapter on applied geophysics summarises and explains with detail the various modern methods of disclosing hidden ore-bodies, now being put to great use in several new mining fields.

Spherical trigonometry and astronomical methods of surveying, triangulation and the methods of correlating underground surveys with those of the surface complete the volume.

For its size, the book contains a remarkable amount of information, all well up to date, is well illustrated and is fully supplied by footnotes with references to the literature of the subject. Both the author and the publisher are to be congratulated.

BAUXITE. By Cyril S. Fox, D.Sc., M.I.M.E., F.G.S. Pp. xii + 312, 10 × 6½. (London: Crosby Lockwood & Son, 1927.) Price 30*s*.

In the sub-title, this book is described as "a treatise discussing in detail the origin, constitution, known occur-

rences, and commercial uses of bauxite; and including particulars regarding the present condition of the aluminium industry and the peculiar importance of cryolite in the extraction of aluminium from bauxite." The author is on the staff of the Geological Survey of India, and in that capacity has surveyed the bauxite deposits of India. His *Bauxite Occurrences of India*, published in 1923 as Part I, Vol. 49 of the *Memoirs of the Geological Survey of India*, is one of the most important publications available on the subject of bauxite. He has also had the advantage of examining bauxite deposits in other lands and has made personal enquiries on the spot into many of the important aspects of the aluminium industry generally.

The first seven chapters of the book are given to the various raw-material aspects of the industry, including the nature and origin of bauxite, its occurrences in various parts of the world, its mining, preparation and marketing. Chapter 8 enumerates the uses of bauxite, including the important recent development of its use in cement manufacture. Chapter 9 gives an account of aluminium metallurgy, and chapter 10 reviews the situation as regards the organisations which control the world's output of bauxite and aluminium. Chapter 11 gives statistical information. Following this there is a lengthy bibliography and the book concludes with an index.

The illustrations are excellent and altogether the book can be highly recommended as a first-rate and up-to-date treatise on bauxite and the aluminium industry.

ALUMINIUM: THE METAL AND ITS ALLOYS. By M. G. Corson. Pp. xx + 291, 9 × 6. (London: Chapman & Hall, Ltd.; New York: D. Van Nostrand Company, 1926.) Price 36*s*.

The author in the preface states that "the book is addressed to readers interested in aluminium, which means those connected with foundry, rolling mill, or structural plant,. and those university students and professors who wish to broaden their knowledge in special branches of the technology of metals." The author also says he has endeavoured to give only such information as may be useful from the industrial point of view.

The work is divided into six main sections—Properties of Aluminium, Systematic Description of Binary and Ternary Systems of Aluminium Alloys, Aluminium and Corrosion, Aluminium Alloys in Engineering Work and, lastly, Structurography of Aluminium and its Alloys.

The second section, dealing with binary and ternary

systems of aluminium alloys, which are dealt with alphabetically, describes in considerable detail the compositions which are or may be used and the properties which can be obtained or expected from each of them. The third section deals with the aluminium alloys used for casting, for wrought shapes, high-temperature work, etc.

The fifth section gives an interesting general description of the uses of aluminium alloys in engineering work and the special points that must be considered in deciding upon their use for a particular purpose. The last section deals with structurography, describing in the main results of investigations carried out by the author. The word "structurography" is used in place of "metallography," as the author considers the latter to be too broad to be applied to structural descriptions.

The book is amply supplied with graphs to explain the points raised, and in addition there appear, as an appendix, some 120 photomicrographic plates, illustrating the different structures of aluminium and its alloys under various conditions. The work is well printed and should be of considerable interest to those who wish to make a close study of aluminium and its alloys, for it is full of detail and shows that the author has a very thorough knowledge of the subject. The price, however, seems rather high, but the reproduction of the large number of microphotographs has no doubt added to the expense of printing.

Annuaire International des Mines et de la Métallurgie. Edition 1927. By Robert Pitaval. Pp. viii + 768, 8½ × 5½. (Paris: Société Publications Minières & Métallurgiques.) Price 30 francs.

The 22nd annual edition of this well-known publication, which is issued on the lines of its immediate predecessorsl but is larger, contains a great deal of data on the minera, and metal industries carried on in most countries of the world. It is particularly useful in giving the names and addresses, in groups or otherwise, of all important mining, metallurgical and chemical companies. In addition there are statistics of production and other commercial information. Naturally France and her colonies receive much attention, with 245 pages, whilst in the "foreign" section, 316 pages are devoted to Europe, 46 to Asia, 15 to Africa, and 97 to North and South America. The book is specially valuable in the facts it gives on Europe and should be of great interest to mining engineers and mining companies.

BOOKS RECEIVED FOR NOTICE

THE ECONOMIC RESOURCES OF THE EMPIRE. Edited by T. Worswick, O.B.E., M.Sc. Pp. viii + 167, 7 × 4¾. (London: Sir Isaac Pitman & Sons, Ltd., 1927.) Price 5*s*.

LE BANANIER. CULTURE-INDUSTRIE-COMMERCE. By Ray. C. P. Boone. Pp. 346, 10 × 6½. (Paris: La Société d'Éditions Géographiques, Maritimes et Coloniales, Maison Challamel, 1926.) Price 60 francs.

THE TIMBER TRADE OF THE UNITED KINGDOM. By Thomas J. Stobart. Volume I. Softwoods. Pp. xiv + 116, 7¼ × 4¾. Volume II. Hardwoods. Pp. xiii + 103, 7¼ × 4¾. (London: Crosby Lockwood & Son, 1927.) Price 5*s*. per volume.

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH—REPORT OF THE FOOD INVESTIGATION BOARD FOR THE YEARS 1925, 1926. Pp. vi + 80, 9½ × 6. (London: H.M. Stationery Office, 1927.) Price 2*s*. 6*d*.

ARTIFICIAL FERTILISERS. THEIR CHEMISTRY, MANUFACTURE AND APPLICATION. By P. Parrish, A.I.C., M.I.Chem.E., and A. Ogilvie, A.M.I.Mech.E., with a Foreword by Dr. H. C. Brown, F.I.C. Volume I. Pp. 356, 9½ × 7. (London: Ernest Benn, Limited, 1927.) Price 45*s*.

SHEEP PRODUCTION. By Levi Jackson Horlacher, B.S.A., M.S. Pp. x + 418, 9 × 6. (New York: McGraw-Hill Book Company, Inc.; London: McGraw-Hill Publishing Co., Ltd., 1927.) Price 20*s*.

F.B.I. YEAR BOOK: A REGISTER OF BRITISH MANUFACTURES. 1927–28. Edited by W. S. Barclay, F.R.G.S., and Ernest A. Nash, Associate I.E.E., A.C.I.S. Pp. 460 + 220, 9½ × 7. (London: Federation of British Industries, 1927.) Price 15*s*.

THE BRIDGE TO FRANCE. By Edward N. Hurley, Wartime Chairman of the United States Shipping Board. Pp. xiii + 338, 8¾ × 5¾. (London: J. B. Lippincott Company, 1927.) Price 21*s*. [An account of the work and achievements of the United States Shipping Board and the Emergency Fleet Corporation in acquiring, building and operating sufficient cargo-ships to maintain an army in France in 1917–18.]

REPORTS OF RECENT INVESTIGATIONS AT THE IMPERIAL INSTITUTE

Selected from the Reports made to the Dominion, Colonial and Indian Governments

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THE VALUE OF SISAL HEMP FOR THE MANUFACTURE OF MARINE CORDAGE

In the following pages is given the report on a first series of Sisal hemp rope tests carried out under the auspices of the Imperial Institute Advisory Committee on Vegetable Fibres.

In view of the statements which have been made from time to time and the general impression which appears to be current that Sisal hemp is unable to withstand the action of sea-water, the Imperial Institute decided in July 1925 to undertake an investigation with the object of determining definitely the effect of sea-water on the strength and durability of the fibre in comparison with Manila hemp. In order to obtain material for the tests application was made to Messrs. Wigglesworth and Co., Ltd., for samples of East African Sisal and Manila hemp of suitable quality.

Samples of East African Sisal of two qualities and a sample of Manila hemp of Grade D were kindly supplied by the firm and submitted to investigation. The results obtained were not concordant owing to the fact that the strands of fibre in a sample vary so greatly in strength; for example, in experiments with Sisal hemp of No. 1 quality the breaking strain of individual strands varied from 350 grams to 2,500 grams, and in an experiment with the Manila hemp D grade the breaking strain ranged between 250 grams and 2,325 grams. Although a large number of tests were made the average results cannot be regarded as affording trustworthy data. In view of this it is not

considered worth while to record the detailed results in the present report.

When supplying the samples of fibre it was pointed out by Mr. Alfred Wigglesworth that it was of great importance that, if possible, the tests should be extended to Sisal ropes, as if it could be shown that Sisal hemp could be used as a substitute for Manila hemp for rope-making it "would mean a great deal of money being kept within the Empire which is now sent out for the purchase of Manila fibre." Mr. Wigglesworth kindly offered to supply the necessary ropes for trial, and discussed the matter with Mr. Hiram Craven of Messrs. Craven and Speeding Bros., Sunderland. In the course of correspondence Mr. Craven stated that a disadvantage of Sisal ropes is that they swell when wetted and will not run easily in the blocks. He added that "for the same reason, viz. that Sisal appears to absorb the moisture and swells, the rope also becomes heavy and for hauling purposes the rope sinks, whereas Manila hemp appears to be very much lighter when in the water, and although I do not claim that it floats on the top, yet it does not readily sink like a stone in the way that Sisal rope does when it is wet." Subsequently Messrs. Craven and Speeding Bros. kindly forwarded three pieces of 3-in. rope, each 300 ft. long, marked No. 1, No. 2 and No. 3. No. 1 was made from first quality British East African Sisal, No. 2 from unbrushed East African Sisal and was a superior No. 2 quality. No. 3 was made from J grade Manila hemp.

A scheme of investigation was drawn up which was designed to test the points in which Sisal hemp has been alleged to be inferior to Manila hemp, viz.:

(1) That its strength deteriorates more rapidly on exposure to sea-water.

(2) That it swells more when wetted and will not run satisfactorily in the blocks.

(3) That it sinks more rapidly.

Description, Character and Composition of the Ropes

After the ropes had been stored for some months under the same conditions, their length and weight were determined as follows:

	Length. feet.	Weight. lb.
I. Sisal, 1st Quality, B.E.A.	295	80
II. Sisal, Unbrushed E.A., Superior No. 2	293	75½
III. Manila, J Grade	294	76

The three ropes were 3-in. hawser laid of 3 strands, 30 yarns to the strand. Measurements of the circumference of the ropes showed that it was rather more than 3 in. but approximately the same in each case; the actual figures are recorded below.

In order to compare the fineness of the fibrous strands of which the different ropes were composed, portions of the ropes were unravelled and the diameters of the fibres determined, 80 measurements being made in each case. The cross-section of the strands not being circular, the largest diameter was measured.

Diameter of Strands of Fibre in the Ropes

	Sisal No. 1. mm	Sisal No. 2. mm.	Manila J. mm.
Maximum	0·46	0·5	0·85
Minimum	0·10	0·10	0·04
Average	0·241	0·207	0·2175

These figures show that the fibre of which Sisal No. 2 rope was composed was finer than that of the Sisal No. 1 rope and that the fibre in both the Sisal ropes was much more regular in diameter than that of the Manila rope.

In order to determine the effect of soaking the ropes in water on their length, weight, girth and twist, measurements were carried out on a piece of each rope about 54 ft. long (1) in the dry condition as received, and (2) after being soaked in tap water for two days. The following results were obtained:

(1) *Dry Ropes*

	Sisal No. 1.	Sisal No. 2.	Manila J
Moisture content, *per cent.*	10·23	10·38	11·1
Weight	14 lb. 15 oz.	13 lb. 15 oz.	14 lb. 1 oz.
Length	53 ft. 4 in.	53 ft. 9 in.	53 ft. 11 in.
Girth	3·24 in.	3·22 in.	3·23 in.
Length of twist	2·5 in.	2·5 in.	2·5 in.

(2) *Wet Ropes*

	Sisal No. 1.	Sisal No. 2.	Manila J.
Weight	20 lb. 12 oz.	20 lb. 8 oz.	21 lb. 8 oz.
Length	50 ft.	50 ft. 9 in.	50 ft. 8½ in.
Girth	3·6 in.	3·5 in.	3·4 in.
Length of twist	2·5 in.	2·5 in.	2·5 in.

These data show that the following variations occur in the ropes when soaked in tap water.

		Sisal No. 1.	Sisal No. 2.	Manila J.
Decrease in length	*per cent.*	6·25	5·58	5·95
Increase in girth	"	11·1	8·69	5·26
Increase in weight	"	38·91	47·37	52·89
Weight per foot dry	*lb.*	0·280	0·259	0·261
Weight per foot wet	"	0·415	0·404	0·425
Alteration in twist		nil	nil	nil

Chemical Examination of the Ropes

The ropes were submitted to chemical examination with the following results:

	Sisal No. 1. *per cent.*	Sisal No. 2. *per cent.*	Manila J. *per cent.*
Moisture	12·0	11·8	12·5
Expressed on moisture-free material:			
α-Hydrolysis, loss	11·6	10·65	13·8
β-Hydrolysis, loss	15·5	13·7	23·25
Cellulose	76·75	79·5	72·2
Matter extracted by light petroleum	6·25	3·8	3·4

These results show that the fibres had the usual composition of Sisal and Manila hemp respectively, but contained an appreciable amount of oil, soluble in light petroleum, which had no doubt been introduced in the course of manufacture. It will be observed that a larger amount of oil was present in the Sisal No. 1 rope than in either of the others.

Method of Carrying Out the Trials

The trials were designed to determine the effect of sea-water on the ropes and were carried out in the following manner. By the courtesy of the Southend Corporation and especially of the Pier Master, Mr. J. C. Herbert, arrangements were made to install a wooden crate on the lower deck at the sea end of Southend pier. The crate was fixed on horizontal cross beams in such a position that it was completely immersed at high tide and completely exposed at low water. The ropes therefore received alternate wetting and partial drying twice a day, all the ropes receiving precisely the same treatment. The crate, which measured 5 ft. 4 in. × 2 ft. 8 in. × 1 ft. 7 in., was specially devised to allow water to flow in and out readily

without beating directly on the ropes. It was divided into three compartments to accommodate the three coils of rope, and precautions were taken to prevent the movement of the ropes and consequent mechanical injury. Portions of the rope 50 ft. in length were withdrawn after four months, six months, nine months and twelve months, and their breaking strain was determined in comparison with untreated portions of the ropes.

Determination of Breaking Strain

The breaking strain of the ropes was determined both before and after treatment with sea-water at Southend. The determinations were made on a Riehlé machine, portions 9 ft. long being used for each test. An eye was spliced at each end of the test piece by means of two full tucks and one half tuck, leaving a free test length of about 2 ft. The eyes were placed on cylinders $4\frac{1}{2}$ in. in diameter which were caused to move apart at the same speed ($\frac{1}{3}$ in. per minute) until the rope broke. The splicing was performed throughout by the same person, an ex-naval rigger, in precisely the same manner.

After each period of exposure to the action of sea-water six tests were made. In order that the ropes might be in the same condition in the tests in respect of humidity all the test pieces were soaked in fresh water for 24 hours and tested in a water-saturated condition. The results obtained are given in the following tables. It may be mentioned that the ropes before treatment in an air-dry condition gave the following average breaking strains: Sisal No. 1, 6,680 lb.; Sisal No. 2, 8,080 lb.; Manila J, 7,550 lb.

Breaking Strain of Ropes before Immersion in Sea-water

	Sisal No. 1. *lb*	Sisal No 2 *lb.*	Manila J *lb.*
	6,890	8,500	7,960
	6,300	8,740	7,780
	7,120	8,930	8,030
	6,350	8,630	8,060
	6,800	8,400	7,800
	6,990	8,940	7,890
Average	6,740	8,690	7,920
Range	6,300–7,120	8,400–8,940	7,780–8,060

Breaking Strain of Ropes after 4 Months' Immersion in Sea-water

	Sisal No 1	Sisal No 2	Manila J
	lb	lb	lb
	4,000	4,180	4,620
	4,190	4,210	4,450
	4,680	4,300	4,340
	4,330	4,310	4,850
	4,470	4,190	4,850
	4,600	4,320	4,370
Average	4,378	4,250	4,580
Range	4,000–4,680	4,180–4,320	4,340–4,850

Breaking Strain of Ropes after 6 Months' Immersion in Sea-water

	Sisal No 1	Sisal No 2	Manila J
	lb	lb	lb
	3,440	3,570	3,520
	3,650	3,590	3,750
	3,540	3,270	4,170
	3,700	3,310	4 200
	3,590	3,690	3,980
	3,640	3,350	3,810
Average	3,593	3,463	3,905
Range	3,440–3,700	3,270–3,690	3,520–4,200

Breaking Strain of Ropes after 9 Months' Immersion in Sea-water

	Sisal No 1	Sisal No 2	Manila J
	lb	lb	lb
	3,080	2,740	3,710
	3,400	2,890	3,720
	3,450	3,110	4,100
	3 150	3,270	3,780
	3,100	3,470	3,600
	3,810	2,900	3,420
	3,190		
Average	3,311	3,063	3,721
Range	3,080–3,810	2,740–3,470	3,420–4,100

Breaking Strain of Ropes after 12 Months' Immersion in Sea-water

	Sisal No 1	Sisal No 2	Manila J
	lb	lb	lb
	3,210	1,810	2,380
	2,440	2,210	2,710
	2,430	2,500	2,780
	2,900	2,100	2,040
	1,930	2,580	2,000
	2,020	1,890	2,970
Average	2,488	2,181	2,480
Range	1,930–3,210	1,810–2,580	2,000–2,970

Summary

Average Breaking Strains (in lb.)

	Sisal No 1.	Sisal No 2.	Manila J.
Before exposure to sea-water	6,740	8,690	7,920
After 4 months' exposure to sea-water	4,378	4,250	4,580
" 6 " " " "	3,593	3,463	3,905
" 9 " " " "	3,311	3,063	3,721
" 12 " " " "	2,488	2,181	2,480

Percentage Loss in Strength

	Sisal No. 1	Sisal No 2.	Manila J
After 4 months' exposure	35	51	42
" 6 " "	47	60	51
" 9 " "	51	65	53
" 12 " "	63	75	69

These results show that at each stage of the trial the Sisal No. 1 rope had suffered less deterioration than the Manila rope, whilst the Sisal No. 2 rope had shown a somewhat greater deterioration. The Sisal No. 1 rope thus withstood the action of sea-water throughout the year better than the Manila rope whilst the Sisal No. 2 rope was more affected than the latter.

In general, however, the trials have indicated that Sisal and Manila hemps do not differ greatly in their resistance to the action of sea-water but that, when exposed under the same conditions, they deteriorate at approximately the same rate.

Swelling of the Ropes when Immersed in Sea-water

On pages 361 and 362 figures have been given of the girth of the ropes in both the dry and wet state. Those figures represent the average of measurements of the ropes at twenty different places in the length of a portion of each rope 54 ft. long. In the following table the maximum, minimum and average results are given, together with similar measurements made on other pieces of the same ropes after having been immersed in sea-water for four months.

	Girth in inches. Maximum.	Minimum.	Average.
Sisal No. 1 :			
Dry	3·25	3·20	3·24
Wet	3·70	3·50	3·60
After 4 months' immersion at Southend	3·80	3·40	3·54
Sisal No. 2 :			
Dry	3·25	3·20	3·22
Wet	3·60	3·50	3·53
After 4 months' immersion at Southend	3·80	3·30	3·42
Manila J :			
Dry	3·30	3·20	3·23
Wet	3·50	3·40	3·41
After 4 months' immersion at Southend	3·60	3·10	3·34

The actual and percentage increases in girth in the three ropes when (1) soaked for 48 hours in tap water, and (2) after being exposed to the action of sea-water for four months, are therefore as follows :

(1) *Ropes Soaked in Fresh Water for 48 Hours*

	Actual average increase of girth in	Percentage increase of girth
Sisal No. 1	0·36	11·10
Sisal No. 2	0·28	8·69
Manila J	0·17	5·26

(2) *Ropes Exposed to the Action of Sea-water for 4 Months*

	Actual average increase of girth in	Percentage increase of girth
Sisal No. 1	0·30	9·26
Sisal No. 2	0·20	6·21
Manila J	0·11	3·60

It is evident therefore that the Sisal hemp ropes on immersion in water swell to a greater extent than the Manila rope. The difference is fairly considerable and in this respect the Manila rope appears to possess an advantage over the Sisal rope.

Relative Buoyancy of the Ropes

The Manila rope does not sink in salt water for some considerable time, whereas the Sisal ropes sink almost immediately.

The following experiments were made with specimens of fibre in order to determine the length of time taken for

Manila and Sisal hemp respectively to sink in water when treated under the same conditions. In these experiments strands of fibre were employed in preference to a section of rope which would contain more or less oily matter introduced during the process of manufacture.

Experiment 1. Small bundles each consisting of 100 strands of different grades of Manila and Sisal hemps cut to lengths of 6 in. were tied at each end with the same length of cotton thread in each case. The bundles were then submerged at the same depth under water (2 in.) and moored in position by cotton threads secured to the middle of the bundle and to weights at the bottom of the vessel. The time taken for the bundles to sink was then noted, the results obtained being as follows :

Fibre.	Grade.	Weight of bundle	Time taken to sink	
		grams	min	sec
Manila hemp .	F	0·46	20	0
,, ,, .	G	1·32	6	0
,, ,, .	L 1	2·43	4	0
Sisal (Java) .	Kobla "A"	0·64	0	25
,, ,, .	Sockamandi "X"	0·43	0	30
,, (Mexican) .		0·85	1	0
,, (East African) .	No. 1	0·56	0	20
,, ,, .	No. 2	0·40	0	30

It will be seen from these results that the length of time taken for the samples of Sisal hemp to sink ranges from 60 secs. to 20 secs. and that of the five samples the Mexican variety had the greatest buoyancy. The buoyancy of the Manila hemps was far superior to the Sisal hemps, the lowest grade taking four minutes to sink and the highest grade no less than 20 minutes.

Experiment 2. In this experiment bundles of the same samples of fibre as above but each of the *same weight* (namely 1·5 grams) and 6 in. in length were treated under conditions similar to those employed in Experiment 1, and the following results were obtained :

Fibre.	Grade.	Time taken to sink.	
		min	sec.
Manila hemp	F	30	0
	G	11	0
	L.I.	6	0
Sisal (Java)	Kobla "A"	0	45
	Sockamandi "X"	1	10
(Mexican)		1	30
(East African)	No. 1	0	45
	No. 2	1	20

These results are very similar to those obtained in Experiment 1 and demonstrate very clearly the superior buoyancy of Manila hemp. It is therefore quite clear that Manila hemp is greatly superior in buoyancy to Sisal hemp.

This difference in buoyancy is probably not due to any great difference in the chemical composition of the fibres, but to the readiness with which they absorb moisture, and it seems not unlikely that this is largely dependent on differences in the surface of the fibre which give rise to differences of surface tension in contact with water.

Conclusions

The results of these trials have indicated (1) that East African Sisal hemp of No. 1 quality withstands the action of sea-water as well as or even better than Manila hemp of the " J " grade, whereas East African Sisal hemp of No. 2 quality is slightly inferior in this respect to Manila hemp, (2) that when immersed in water the Manila rope does not increase in girth so much as the Sisal ropes, and in this respect Manila hemp is superior to Sisal, (3) Sisal fibre sinks far more rapidly in water than Manila hemp.

A further series of trials is now being carried out on similar lines.

HEMP FROM CYPRUS

The cultivation of hemp (*Cannabis sativa*) in Cyprus is practically confined to places in the southern part of the Paphos district, where an ample supply of water is available for retting the fibre. There is at present no export of the fibre, which is used exclusively for hand-made ropes produced by the villagers in the neighbourhood of Kitima. An account of the method employed for growing and preparing the fibre in the Island is given in an article, entitled " Notes on Agriculture in Cyprus," by W. Bevan, published in this Bulletin (1919, **17**, 522).

A sample of hemp produced in the Paphos district was received for examination at the Imperial Institute in August 1927. It consisted of fibre varying in colour from

cream to pale brown. The fibre had been fairly well prepared, but still contained some shieve and other woody tissue. The fibre was of good strength and of excellent length, ranging from 6 ft. to 10 ft. and being mostly about 8 ft.

A portion of the sample, after having been combed in order to free it from woody fragments, was submitted to chemical examination in comparison with a commercial sample of Italian hemp. The following results were obtained :

	Sample from Cyprus *Per cent*	Commercial sample of Italian Hemp. *Per cent*
Moisture	10.7	9.2
Calculated on the moisture-free material		
Ash	1.4	2.3
α-Hydrolysis, loss	11.1	10.2
β-Hydrolysis, loss	19.2	18.8
Acid purification, loss	2.4	2.5
Water washing, loss	1.1	1.3
Cellulose	81.5	83.8

These results indicate that the Cyprus hemp is of satisfactory quality and very little inferior in chemical composition and behaviour to the Italian hemp with which it was compared. It suffers slightly greater loss on treatment with hot dilute alkali (α– and β–hydrolysis) and does not contain quite so high a percentage of cellulose.

The hemp was submitted to microscopical examination and it was found that the ultimate fibres possessed the form and character of those of ordinary European hemp (*Cannabis sativa*). The length and diameter of the ultimate fibres were measured with the following results :

	Length *mm*	Diameter *mm*
Maximum	50.0	0.051
Minimum	6.0	0.010
Average	24.0	0.027

These dimensions agree with those recorded for the fibre of ordinary European hemp.

A portion of the sample was submitted to Messrs. Wigglesworth and Co., Ltd., for their opinion as to its quality and commercial value. They reported as follows :

" Well grown hemp, 7–8 ft. in length, good colour,

carefully prepared, but some trace of stick which should be removed in future deliveries, good strength.

" In our estimation this fibre compares well with low qualities of Naples, the value being from £60 to £65 per ton. The fibre is rather dry, due in our opinion to the essential oil being removed in retting.

" We could get fair quantities placed, and shall be glad to receive a sample lot of, say, 10 tons, to put before our principal spinners for testing purposes."

The results of this investigation showed that the sample of Cyprus hemp was of good quality and would be readily saleable in the London market. It was pointed out to the Cyprus authorities that it is desirable that if possible a trial consignment should be forwarded as suggested above.

BAMBOOS FROM BRITISH GUIANA FOR PAPER-MAKING

THREE samples of bamboo from British Guiana were received for examination at the Imperial Institute in June 1927. It was desired that the suitability of the bamboos for the manufacture of paper pulp should be determined.

The samples were described as follows :

No. 1.—" From clump at Kartabo Point, junction of Mazaruni and Cuyuni River, sandy soil ; stems, twigs and leaves."

No. 2.—" From Botanic Gardens, Georgetown, clay soil ; stems only. This lot appears to be similar to No. 1."

No. 3.—" From lower slope of Issororo Hill, Aruka River, North West District, in laterite soil (decomposed dolerite) ; stems only."

It was stated that No. 3 appeared to be an indigenous species and herbarium specimens were forwarded for identification. These specimens and also specimens of the leaves and stems of sample No. 1 were submitted to the Director of the Royal Botanic Gardens, Kew, who reported as follows :

" The specimens referred to as No. 3 and collected by Box (No. 562), from the lower slope of Issororo Hill,

match very well the Kew sheets of *Guadua angustifolia* Kunth, and are almost certainly that species. The bamboo marked No. 1 is a species of Guadua, very near to, if not identical with, *G. angustifolia* Kunth. In either case flowers are necessary to ensure exact determination."

The samples received for examination were as follows :

No. 1.—This weighed 98 lb. and consisted of portions of yellowish-brown stems mostly bearing branches. A considerable quantity of detached leaves was present. The stems varied in length from 6 to 8 ft. and in diameter from 1½ to 3½ in. The distance between the nodes varied from 9 to 16 in.

No. 2.—This also weighed 98 lb. and consisted of stems varying in colour from yellowish-brown to brown and ranging in length from 4 ft. 6 in. to 6 ft. 3 in. and in diameter from 2½ to 4 in. In general the stems were similar to those of No. 1, but were free from side branches.

No. 3.—This consisted of 56 lb. of brownish-yellow stems from which the branches had been removed. The stems were rather dirty and discoloured, and differed in appearance from those of Nos. 1 and 2. They varied in length from 4 to 5 ft. and in diameter from 4 to 5 in. The distance between the nodes varied from 3½ to 7 in.

The samples were submitted to chemical examination and furnished results which are given below in comparison with the corresponding figures obtained for samples of an Indian bamboo (*Bambusa Tulda*) and an East African bamboo (*Arundinaria alpina*) previously examined at the Imperial Institute.

	British Guiana Bamboos			*Bambusa Tulda*	*Arundinaria alpina*
	No. 1 *	No. 2.	No. 3.	India	East Africa
Moisture . *per cent.*	10·7	10·5	12·7	8·6	9·5
Ash . . *per cent.*	2·7	1·4	3·2	2·5	3·6
Cellulose, expressed on the material as received . *per cent.*	44·7	53·0	45·6	53·4	47·5
Cellulose, expressed on the moisture-free material . *per cent.*	50·0	59·2	52·2	58·4	52·5

* *The chemical examination of this sample was carried out on the stems and branches, after removal of the leaves.*

The lengths and diameters of the ultimate fibres wer determined with the following results :

Length in mm.

	British Guiana Bamboos. No. 1.	No. 2.	No. 3.	Bambusa Tulda.	Arundinaria alpina.
Maximum . . .	4·7	4·6	4·0	3·6	2·7
Minimum . . .	0·9	1·0	1·0	1·8	1·6
Mean	2·6	2·4	2·3	2·4	2 3

Diameter in mm.

	No. 1.	No. 2.	No. 3.	Bambusa Tulda.	Arundinaria alpina.
Maximum . . .	0·038	0·038	0·056	—	—
Minimum . . .	0·005	0·008	0·008	—	—
Mean	0·018	0·020	0·023	—	—

Paper-making trials.—In each case the chipped stems (including the nodes) were submitted to treatment with caustic soda under conditions similar to those employed in the manufacture of paper pulp on a commercial scale.

The following results, expressed on the material as received, were obtained :

Sample	Trial	Caustic soda used		Conditions of digestion		Parts of caustic soda consumed per 100 parts of stems	Yield of dry pulp.	
		Parts per 100 parts of stems	Parts per 100 parts of solution	Time	Temp		Un-bleached	Bleached
				hrs	°C		*Per cent*	*Per cent.*
No. 1*	A	20	4	4	160	10·0	40	35
No. 2	A	20	4	4	160	9·1	46	39
No. 3	A	20	4	4	150	9·4	49	— *
,,	B	20	4	4	160	9 5	42	39
,,	C	20	4	5	160	9 4	40	35

* *The pulping trials were carried out on stems and branches only.*

No. 1.—The conditions of digestion in Trial A were just sufficient to produce a well-reduced pulp containing only a very slight proportion of undisintegrated material. The pulp furnished a pale brown paper of excellent strength and bleached fairly readily. The bleached pulp furnished a cream-coloured opaque paper of excellent strength and quality.

No. 2.—The conditions of treatment in Trial A were sufficient to produce a well-digested pulp containing only a very slight amount of undisintegrated material. The pulp furnished a pale brown paper of excellent strength. The pulp bleached fairly readily, furnishing a cream-coloured opaque paper.

No. 3.—The conditions of treatment in Trial A were not sufficiently severe to reduce the material to a satisfactory pulp. The pulp obtained in this trial furnished a yellowish-brown paper which was rather weak and contained a considerable amount of undisintegrated material. The increased temperature employed in Trial B yielded a fairly well-digested pulp. This pulp furnished a yellowish-brown paper of similar strength to that produced in Trial A but containing only a small amount of undisintegrated material. The pulp could not be bleached as even when a strong bleaching solution was employed the colour was only slightly reduced ; the paper made from this pulp was of similar strength to that of the unbleached paper.

The increased time of digestion in Trial C yielded a well-digested pulp, which furnished a pale brown paper of fairly good strength. The pulp did not bleach very readily, but gave a dark cream-coloured opaque paper of similar strength to the unbleached paper.

The results of the examination of these bamboos are summarised in the following table, which shows in each case the conditions of treatment employed. For purposes of comparison the yields of pulp and the soda consumption have been calculated on the basis of air-dried material containing 10 per cent. of moisture. The corresponding figures for *Bambusa Tulda* and *Arundinaria alpina* are added for comparison :

Sample.	Trial	Caustic soda used.		Conditions of digestion.		Parts of caustic soda consumed per 100 parts of stems	Yield of dry pulp	
		Parts per 100 parts of stems	Parts per 100 parts of solution	Time.	Temp.		Un-bleached	Bleached
				hrs	°C		*Per cent*	*Per cent.*
No. 1	A	20	4	4	160	10·1	40	35
No. 2	A	20	4	4	160	9·2	46	39
No. 3	C	20	4	5	160	9·7	41	36
Bambusa Tulda		20	4	7	160	10·6	47	—
Arundinaria alpina		20	4	7	160	11·5	34	—

The results of this investigation show that of the three samples of bamboo from British Guiana, No. 2 contained the highest percentage of cellulose and gave the best yield of pulp. Rather lower but fairly good yields of pulp were obtained from Samples Nos. 1 and 3. The papers prepared

from Samples No. 1 and No. 2 were practically identical in character and of excellent strength and quality. The results obtained with Sample No. 3 were not so satisfactory and somewhat more severe conditions of treatment were necessary to reduce the material to a satisfactory pulp. Moreover, the pulp yielded by No. 3 was inferior to Nos. 1 and 2 in quality and more difficult to bleach. The paper which it furnished was appreciably weaker than that obtained from the other two samples.

It will be observed that the average length of the ultimate fibres of Sample No. 3 was less and the average diameter greater than in the case of either of the other samples, and this would partly account for the poorer felting power and inferior strength of the pulp obtained from this sample.

The soda consumption was satisfactorily low in all cases.

In general the results show that Samples Nos. 1 and 2, which appear to be derived from the same species of bamboo, furnished pulp of similar quality. Sample No. 1, which included branches, furnished a lower yield of pulp than No. 2, which consisted entirely of stems and required more soda for conversion into pulp.

Sample No. 2 compares very favourably as a paper-making material with the Indian *Bambusa Tulda* and the Kenya bamboo, *Arundinaria alpina*. The yield of pulp is approximately equal to that from the former, and larger than that from the latter, while the quality of the paper produced from the pulp is excellent. The bamboo would be highly suitable for the commercial production of paper pulp.

MINERALS FROM KENYA FOR THE PRODUCTION OF STRUCTURAL MATERIALS

In previous issues of this Bulletin, reports have been published giving the results of investigations carried out at the Imperial Institute on certain minerals from Kenya which might be used for structural purposes. These included brick clays, a diatomaceous material suitable

for the production of light tiles or partitions (1921, **19**, 303) and limestones and clays suitable for making Portland cement (1924, **22**, 437).

Early in 1926, at the request of the Government of Kenya Colony and by arrangement with the Government of Uganda, the services of Mr. E. J. Wayland (Director of the Geological Survey of Uganda) were obtained for the purpose of investigating possible sources of mineral substances which might be used in the manufacture of bricks, lime and cement in Kenya. Owing to the short time available (one month) it was only possible to make a preliminary investigation. The field work was chiefly concerned with a reconnaissance along the railway line of the country between Mombasa and Kisumu. About 107 samples were collected, and of these 26 were sent to the Imperial Institute for complete chemical analysis and report, as the chemical staff necessary for the work could not be spared either in Kenya or Uganda.

An interesting report on the tour has been prepared by Mr. Wayland under the title of " Report on Some Mineral Substances which may be used in the Production of Bricks, Limes and Building Stones in Kenya Colony." This, however, did not include the full results of the chemical analyses made at the Imperial Institute, as it had been arranged that these should appear in this BULLETIN.

The following details taken from the report of Mr. Wayland regarding the occurrence of the more important building materials in Kenya may be of interest in connection with the present samples: *Sedimentary limestones* are generally grey in colour, stratified and frequently interbedded with shales, being sometimes more or less sandy or clayey. Most of the sedimentary limestones if burnt would give " fat " limes. *Crystalline limestones* sometimes occur very pure, such as those near the Voi railway bridge, but many contain mineral impurities, particularly magnesium compounds. Some would give hydraulic lime on burning. *Concretionary limestones*, also known as " kunkar," occur as more or less nodular accumulations of calcium carbonate at or near the junction of the soil and bedrock. In some places the kunkar nodules have

been cemented together by carbonate of lime so as to form more or less definite limestone beds such as at Kiambu and near Makindu. Some varieties will yield hydraulic lime on calcination. *Brick clays.*—Considerable attention was devoted by Mr. Wayland to possible clays and loams which might be used for brickmaking, and a table of localities where suitable material may be found is included in his report.

The descriptions of the samples examined at the Imperial Institute, together with the localities from which they were obtained, were as follows:

Limestones

Sample No.	Description and Locality. (Miles quoted are those on the Kenya-Uganda Railway)
614.	Greyish speckled rather fine-grained limestone—Mwachi Gorge.
615.	Similar to 614 but coarser in texture Same locality.
616.	Concretionary calcareous nodules from the Changamwe shales. Mouth of Mwachi Gorge, left bank
628.	Concretionary calcareous nodules. Gulley below Miritini station.
638.	Hard nodular kunkar. Between Ml. $\frac{41}{2}$ and $\frac{41}{3}$.
643.	Hard kunkar. Near Ml 57.
645.	Hard pinkish conglomeratic kunkar. Ml $\frac{16}{3}$ Voi-Taveta Railway.
646.	Hard red-brown conglomeratic kunkar. Ml. 6 Voi-Taveta Railway
647.	White kunkar. Ml. $\frac{4}{14}$ Voi-Taveta Railway.
649.	White metamorphic crystalline dolomitic limestone. Ml $\frac{136}{5\frac{1}{2}}$.
651.	Kunkar associated with 649.
654.	Nodular kunkar. Between Tsavo and Ml $\frac{136}{5\frac{1}{2}}$.
655.	Light-brown compact kunkar. Approximately two miles N 15° E of Makindu station.
656	Hard kunkar mottled with brownish spots. Same locality as 655
657.	Soft white kunkar. Same locality as 655.
660.	Hard kunkar, near Athi River station.
661.	Volcanic tuff. Junction of Ngong and Dargoretti roads.

Shales, etc.

617.	Grey-brown very fine-grained calcareous sandstone.
624.	Hard grey shale. Kibiongoni.
625.	Siliceous grey limestone. Gulley below pumping station at Ml. $\frac{11}{6}$.
627.	Concretionary siliceous claystone. Ml $\frac{11}{5}$.
630.	Grey calcareous shale Miritini.
644	Granular dolomitic limestone. Voi Bridge, Taveta Railway.
652	Hornblende-mica-schist impregnated with calcium carbonate.
653.	Siliceous red-earth, Makindu.

The results of the chemical analyses of the above samples carried out at the Imperial Institute are shown in the following table:

Sample No		614	615	616	617	624	625	627	628	630	638	643	644
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Lime	CaO	44 18	49 97	19 00	9 98	2 57	5 88	0 30	18 51	5 54	46 87	46 17	33 21
Magnesia	MgO	1 14	0 17	1 59	1 53	2 98	9 09	1 07	3 35	2 28	2 25	2 64	19 51
Alumina	Al_2O_3	0 13	0 21	2 78	8 02	16 35	13 58	9 18	5 38	13 96	1 88	3 62	0 31
Ferric oxide	Fe_2O_3	0 66	0 62	3 58	5 86	7 35	9 20	2 28	9 33	6 43	0 58	0 82	0 15
Titanium dioxide	TiO_2	trace	trace	0 48	0 40	1 11	0 46	0 42	0 43	0 74	trace	trace	nil
Manganous oxide	MnO	—	—	—	—	0 11	0 28	trace	—	0 03	—	—	—
Barium oxide	BaO	—	—	—	—	0 09	nil	nil	—	0 09	—	—	—
Potash	K_2O	—	—	—	—	2 56	0 18	1 40	—	1 06	—	—	—
Soda	Na_2O	—	—	—	—	0 82	1 88	nil	—	1 32	—	—	—
Sulphuric anhydride	SO_3	0 32	0 20	0 49	0 10	—	—	—	7 90*	—	0 23	0 15	0 02
Phosphoric anhydride	P_2O_5	trace	trace	0 48	0 07	0 09	0 24	0 02	1 40	0 01	trace	trace	nil
Silica (combined)	SiO_2	1 86	1 41	6 66					7 96		1 60	2 16	
Silica (free)	SiO_2	16 76	7 85	46 13	62 62	55 40	44 74	80 84	15 16	58 51	5 94	4 34	0 22
Moisture at 110° C	H_2O					4 28	0 68	1 58		3 08			
Combined water	H_2O	34 30	38 96	16 15	9 47	3 72	2 54	2 90	15 56	3 42	40 14	40 46	46 86
Carbon dioxide	CO_2					1 60	10 82	nil		3 34			

Sample No		615	64[illegible]	[illegible]17	649	651	[illegible]	6[illegible]3	6	655	656	65[illegible]	6[illegible]	6[illegible]1
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Lime	CaO	42 54	45 55	49 86	28 32	41 93	29 03	0 34	39 31	48 28	52 16	50 74	48 00	trace
Magnesia	MgO	8 30	1 25	0 77	21 44	3 46	3 03	0 41	5 19	1 07	0 72	0 53	3 00	1 17
Alumina	Al_2O_3	1 54	1 02	0 75	1 59	3 20	9 74	21 37	3 63	2 67	0 23	0 27	0 73	17 92
Ferric oxide	Fe_2O_3	0 67	2 06	0 65	0 11	1 98	4 64	5 21	1 65	1 47	0 61	0 98	1 07	7 50
Titanium dioxide	TiO_2	0 15	0 52	0 23	trace	0 16	0 70	1 48	0 16	0 18	0 08	trace	trace	0 60
Manganous oxide	MnO	—	—	—	—	—	—	trace	—	—	—	—	—	0 56
Barium oxide	BaO	—	—	—	—	—	—	nil	—	—	—	—	—	—
Potash	K_2O	—	—	—	—	—	—	0 56	—	—	—	—	—	—
Soda	Na_2O	—	—	—	—	—	—	0 04	—	—	—	—	—	—
Sulphuric anhydride	SO_3	0 19	0 07	0 08	0 08	0 12	0 27	—	0 14	0 13	0 17	0 10	0 06	0 15
Phosphoric anhydride	P_2O_5	trace	0 05	0 03	0 07	0 01	0 05	0 02	trace	0 02	0 01	0 05	0 05	—
Silica (combined)	SiO_2	nil	3 63	2 75		0 27			1 06	2 82	0 63	2 72	3 18	
Silica (free)	SiO_2	3 16	9 26	2 95	12 00	13 12	29 12	59 37	11 69	3 26	2 71	2 15	2 00	57 42
Moisture at 110° C	H_2O							2 95						1 43
Combined water	H_2O	42 74	35 94	40 82	36 22	35 09	22 02	8 71	36 75	39 96	42 33	41 95	41 54	
Carbon dioxide	CO							nil						3 42

* *This figure includes 7 70 per cent of sulphuric anhydride occurring in the sample as barium sulphate, which was present to the extent of 22 46 per cent*

Remarks

In the following comments on the above results the term "Portland cement" is used to imply a material complying with the requirements of the British Standard Specification, 1925, unless reference is made otherwise.

Portland cement.—Limestone of the quality represented by sample No. 638 could be employed for this purpose if used in conjunction with suitable clays or shales. Thus it could be used with No. 630 or with any clay of fairly normal composition. Limestone No. 643 would require to be incorporated with a clay containing a fairly high percentage of silica such as Nos. 617 or 627.

A limestone represented by sample No. 647 could be used for making Portland cement in conjunction with a clay having a fairly low content of silica (i.e. about 53 per cent.), and a ratio of silica to alumina of about 2·4 to 1. Samples Nos. 645, 649, 651 and 654 contain too much magnesia to permit of their being used for making British Portland cement, but one complying with the German or United States Specifications could be made from No. 651 in conjunction with a clayey limestone having a composition roughly as follows: silica, 15 per cent.; iron oxide, 2·5 per cent.; alumina, 6 per cent.; lime, 39 per cent.; magnesia, 1·5 per cent.

No. 646 contains too large an amount of silica to permit its being used in cement making.

Sample No. 653 could be employed for making Portland cement if mixed with a limestone similar to No. 656 (see below). Suitable proportions would be 4 parts of No. 656 to 1 part of No. 653, and if such a mixture were well burnt there should result a good-quality Portland cement. It should be noted, however, that sample No. 657, although somewhat similar to No. 656, would not be so suitable for use in this connection.

Sample No. 655 could be employed if used in conjunction with a clay or shale having a fairly high ratio of silica to alumina: for example, a suitable clay would be one containing approximately the following percentages: silica, 53; alumina, 16; ferric oxide, 7; lime, 2; magnesia, 1.

Limestones represented by samples Nos. 656 and 657

could also be so used in conjunction with a clay containing about 53 per cent. of silica and a ratio of silica to alumina of about 2·4 to 1. Sample No. 624 also could be used in conjunction with No. 656 in the proportion of about one part of the former to 3·6 parts of the latter. Such a mixture, if well burnt, should yield a Portland cement of high tensile strength.

If sample No. 660 were used in conjunction with a clay of normal composition it is probable that the cement produced would contain over 4 per cent. of magnesia and hence would fail to comply with the British Standard Specification. If, however, the limestone were used in conjunction with a more clayey limestone a cement having a chemical composition within the limits of the Specification could be produced. A suitable clayey limestone would be one having approximately the following percentage composition: silica, 18·3; alumina, 6·0; ferric oxide, 1·8; lime, 36·4; magnesia, 2·2.

Sample No. 661 could probably be used for making Portland cement in conjunction with a suitable limestone, but much would depend upon the behaviour of such a mixture in the kiln as it would be necessary there to volatilise much of the alkali present. Hence technical trials would be necessary before a definite opinion could be expressed on the possibility of using the material in cement manufacture. As an example of the class of limestone which would be most suitable for admixture, sample No. 638 may be mentioned. The proportions required would be about 6·25 parts by weight of sample No. 638 to 1 part of sample 661.

Of the remaining samples analysed, Nos. 625, 644, 645, 649 and 654 contain too much magnesia, whilst the percentage of silica is too high in Nos. 614, 616, 628, and too low in No. 652.

Lime.—No. 614, on burning, would give a lime contaminated with much silica, but the product might be useful for certain building purposes. Material represented by samples Nos. 638, 643, 651, 654 and 655, if burnt at suitable temperatures, might give feebly hydraulic limes.

Samples Nos. 615, 645, 646, 647, 656, 657 and 660 on burning would give products belonging to the class of

" fat " or plastering limes which, although of rather inferior quality for this purpose, could be used for building. The lime obtained from Nos. 644 and 645 would require to be thoroughly slacked before use, in order to avoid any possible trouble due to the high content of magnesia. No. 646 would give only a poor quality lime owing to the large percentage of free silica present. Sample No. 649 could not be used for lime burning owing to its high content of magnesium silicate and low percentage of lime.

It will be seen from the above results that many of the materials collected during Mr. Wayland's brief tour along the Uganda railway could be employed for the production of good-quality Portland cement to conform to the requirements of the British Standard Specification (1925). No limestones likely to give eminently hydraulic limes were located, but some, on burning, would give feebly hydraulic limes, whilst others would yield " fat " or plasterer's limes.

ARTICLE

TANNING MATERIALS OF THE BRITISH EMPIRE

PART II

The first part of this article, published in the preceding number of this Bulletin (pp. 250–286), dealt with the distribution and uses of some of the better-known tanning barks, including wattle, mangrove, mallet and hemlock barks, and also with avaram and babul barks of India. The present part continues the review of the tanning barks of the Empire (oak and larch) and deals also with tanning woods (chestnut and cutch), and leaves (gambier and sumach).

Oak Bark and Other Oak Products

One of the oldest and best known of tanning materials, at least as far as the United Kingdom is concerned, is oak bark, which has been used in the preparation of leather for many centuries. This material is particularly suitable for sole and other heavy leathers, but it penetrates the hide so slowly that the tanning process is rather long.

In consequence, oak bark has in many tanneries been replaced by other materials with quicker tanning properties, while on the Continent it has been blended with pine bark, and in the United States with hemlock and chestnut extract. Nevertheless, in spite of this defect, and of its being one of the most expensive tanning materials, it is the most suitable material for the best grades of heavy leather. The consumption in Great Britain and Ireland in 1925 of oak and larch bark together was 10,000 tons, which represents about 7 per cent. of the total consumption of tanning materials in these countries. The whole of the oak bark used in the United Kingdom is from home supplies and none is exported.

The British oaks comprise two species, viz. *Quercus pedunculata* Ehrh., which occurs chiefly in lowland districts, and *Q. sessiliflora* Salisb., which is commoner in hilly regions. The best time of year for collecting the bark is between the middle of April and the middle of June, and it should be stripped as soon as possible after the trees have been cut down. In cases where the trees have been felled for some time before they are peeled, steam is occasionally used to assist in the stripping. The stripped bark is piled in stacks and allowed to dry, care being taken to prevent damage by rain and overheating. English bark is sometimes sold in " long rind " and sometimes " hatched " or chopped into pieces, 4 in. long. Belgian and Dutch bark is usually hatched.

The best qualities of English oak bark are obtained from Sussex and Hampshire and contain from 12 to 14 per cent. of tannin. The average content of European oak bark is from 8 to 13 per cent., a good sample containing not less than 10 per cent.

Young coppice bark is richest in tannin and gives more satisfactory results than older bark. The coppice bark is obtained from plantation oaks less than 20 years old. Bark from older trees is less rich in tannin on account of the large amount of " ross " which covers the outer surface.

Oak bark is generally used as such in tanneries and is not often made into extract, although parcels of the extract are occasionally offered on the market. The

bark of the American chestnut oak, *Q. Prinus* L., is used in the Alleghanies for this purpose and is stated to furnish the best oak bark extract manufactured.

The genus *Quercus* comprises numerous species, which are distributed widely over the northern hemisphere and are found also in Java and the mountains of Mexico and South America. Not every species, however, yields bark sufficiently rich in tannin for leather production.

Tannin is found not only in the bark of oak trees, but occurs also in other parts of the tree, such as the leaves, acorns and wood. The leaves of some species contain over 10 per cent. of tannin, but are rarely, if ever, employed commercially.

The cups of the acorns from one species at least, viz. *Q. Aegilops* L., are a valuable tanning material and are known in commerce as valonia; they contain on an average 31 per cent. of tannin. The valonia consumed in the United Kingdom is almost, if not entirely, imported from Asia Minor and Greece. An article dealing with the production and uses of valonia was published in this BULLETIN (1912, **10**, 645).

Oak wood contains from about 5 to 13 per cent. of tannin, but rarely more than 9 per cent. The percentage of tannin reaches its maximum when the tree is about 45 years old. The lower portions of the trunk are richer than other parts while the main root also contains a considerable amount of tannin. Oak wood is used in large quantities for the preparation of a tannin extract, particularly in Jugo-Slavia, and also in Russia, France, Spain and North America. For the purpose of extract manufacture, the heart-wood is considered to be best. Though other parts of the tree may contain more tannin, these also yield a relatively larger proportion of non-tannins. In Jugo-Slavia, the material employed for extract-making is the waste-wood from the furniture factories, supplemented by the larger branches. The species of oak most abundant in that country is *Q. pedunculata*. Oak wood extract is usually sold on a basis of a guaranteed tannin content. The Slavonian product on an average contains from 26 to 28 per cent. of tannin, while the Russian sometimes has over 30 per cent. Oak

wood extract has weight-giving properties and yields a rather darker-coloured leather than does oak bark, even after the extract has been decolourised. It is employed almost exclusively in the preparation of heavy leather and is best used towards the end of the process of tanning. Oak wood extract is stated to be rather rich in glucose and therefore ferments easily. The addition of 0·3 per cent. of sodium fluoride prevents this fermentation. When carefully made and decolourised the extract is excellent for pit-tanning, owing to its swelling action, but if it is desired to employ it in drum-tannage it should be blended with an equal weight of chestnut extract. Oak wood extract appears on the German market in three different strengths, viz. :

	Water *Per cent*	Tannin *Per cent*	Non-tannins *Per cent*
Liquid	55–67	22–30	—
Concentrated . . .	36–40	41–45	15–18
Solid	12–23	54–63	15–28

With the exception of Great Britain and Ireland, the only countries in the British Empire which offer possibilities for the commercial exploitation of oak bark and oak wood are India and Burma.

India.— In this country, particularly in the region of the Himalayas, there exist large numbers of oak trees of various species, but not all of them contain sufficient tannin in the bark or wood to warrant their exploitation on a commercial scale. The barks of several species of Indian oaks compare very favourably with European bark. The extent to which this bark is used in India is practically negligible as other materials, richer in tannin, are available at a lower price. Many of the Indian oaks have been investigated with a view to their commercial utilisation. The commonest species occurring in India is *Q. incana* Roxb., in the bark of which as much as 23·4 per cent. of tannin has been found, although other samples have not shown nearly so high a percentage. The most promising variety is stated to be *Q. fenestrata* Roxb., containing 15·9 per cent. of tannin in the mature bark. This material has the advantage of giving a lighter-coloured leather than the other varieties tested. Other Indian

barks which have been examined are those of *Q. dilatata* Lindl., 6·8–7·9 per cent. of tannin; *Q. semecarpifolia* Sm., 8·6–11·6 per cent.; *Q. pachyphylla* Kurz, 12·2 per cent.; *Q. lineata* Blume, 9·7 per cent.; *Q. lamellosa* Sm., 10 per cent.

Large supplies of oak bark and wood are available in India and it has been suggested that some of the above-named species might be used for the manufacture of extract. As a rule, however, these oak trees grow at high elevations and the cost of transporting the bark from the forests to the central factory below would render it impossible to create a profitable industry.

Burma.—In Burma, as well as in India, there exists a large number of oak trees of various species, many of which have been examined to determine their value as a source of a tanning material. The results have shown that many species are of little or no value. In general the wood is more promising than the bark. It is interesting to note that in the case of some species the wood contains more tannin when collected in the winter than in the summer. Those mentioned in the following list might be used for the manufacture of extract, but, as is the case in India, it is doubtful whether their utilisation for this purpose would be profitable. Small-scale tannages have been carried out on some of these materials, and the leathers produced, together with other results of the investigation, are described in *Indian Forest Records* (1924, vol. x, pt. xi).

		Tannin Per cent
Q. Griffithii Hook.,	bole bark	9·3–10·4
	heart-wood	5·8–7·3
Q. incana Roxb.,	twig bark	19·5
	bole bark	19·4
Q. serrata Thunb.,	twig bark	10·0
	outer bole bark	8·7
Q. Brandisiana Kurz,	twig bark	18·9
	bole bark	32·8
	outer bole bark	17·5
	wood	8·5
Q. spicata Sm. var. *microcalyx*,	twig bark	10·6
	outer bole bark	14·1
	average wood (winter)	8·5
Q. Lindleyana Wall.,	average wood (winter)	9·5
	heart-wood	11·7
Q. fenestrata Roxb. (open-topped acorn variety),	twig bark	8·9
	bole bark	10·6–13·2
	bole wood	10·9–12·2

Of these oaks *Q. fenestrata* (open-topped acorn variety), *Q. spicata* var. *microcalyx* and *Q. Lindleyana* have been recommended as most suitable for re-afforestation purposes.

Although, as shown above, there are large quantities of oaks occurring in both India and Burma, there does not appear to be any immediate prospect of these resources being utilised to augment the existing supplies of tanning materials.

Larch Bark

Larch bark is one of the less commonly used tanning materials in the United Kingdom. It is derived from the tree, *Larix europæa* D.C., which grows in various countries of Europe and is fairly widely distributed. The bark contains from 9 to 10 per cent. of tannin and is suitable for the preparation of light leather. In Scotland it finds employment in the tanning of basils. Owing to the presence of sugars in the bark, a fair amount of acid is produced in the liquors.

The quantity of this material consumed in the tanneries of Great Britain and Ireland is not separately shown in the table on p. 252, but is included with oak bark. The total for these two materials was 10,000 tons in 1925. The whole of the larch bark is of home production, none being either imported or exported. Large quantities of larch bark are used in Russia, Hungary and Austria.

There does not appear to be much likelihood of the use of this material extending, but the bark can be profitably employed in places where the tree grows naturally. In Canada three species of larch occur, namely, *L. americana* Michx. (tamarack), *L. occidentalis* Nutt. (Western larch) and *L. Lyallii* Parl. (Alpine larch). In India *L. Griffithii* Hook. f. is found in the Eastern Himalayas, in Eastern Nepal, Sikkim and Bhutan at an altitude of from 8,000 to 12,000 ft. A sample of bark of the western larch grown in Oregon, U.S.A., was found to contain 10·6 per cent. of tannin, and it was suggested that the material might be utilised on a commercial scale for the preparation of extract.

CHESTNUT

In 1925 the two chief vegetable tanning materials consumed in Great Britain and Ireland were wattle bark and myrobalans, and next in importance was chestnut extract, of which over 25,000 tons were absorbed by the tanning industry in that year. The greater part of this was imported from France and Italy, the latter country supplying a little more than the former. The remainder of the supply, about 1,800 tons, was obtained from the United States of America.

The true or Spanish Chestnut (*Castanea sativa* Mill. = *C. vesca* Gaertn.) grows throughout the greater part of temperate Europe and also in the United States of America as far north as latitude 44°. In Europe it is most prolific in Italy, France, Spain, Switzerland, Jugo-Slavia and Corsica, while in America it abounds in Virginia, Western North Carolina, North Georgia and Eastern Tennessee. Allied species also grow in large numbers in India and Burma.

Chestnut extract of commerce is almost, if not entirely, made from the wood of the chestnut, the bark not being rich enough to allow it to be profitably employed for this purpose. As already indicated, the chief manufacturing countries are France, Italy and the United States. The air-dried wood contains from 8 to 13 per cent. of tannin on the average, although as much as 20·5 per cent. of tannin has been reported for a sample from Corsica. As a rule, chestnut trees grown in northern regions contain less tannin in the wood than do trees grown in southern districts, the usual content being 7 to 8 per cent. for northern and 10 to 11 per cent. for southern wood. The heart-wood is the richest part of the tree, but the sap-wood is also used for extract manufacture. Chestnut extract tans hides and skins rapidly, giving a firm leather, and is used largely in the United Kingdom in conjunction with valonia, myrobalans and other materials for the preparation of sole-leather. Chestnut extract, when used alone, gives a leather of a more reddish colour than that produced by valonia.

Several concentrations of extract are on the market, and their composition is indicated below :

	Moisture. Per cent.	Tannin. Per cent.	Non-tannin. Per cent.	Insoluble. Per cent.
Liquid extract	58–64	29–32	5–7	0·5–1·5
" "	54–59	32–37	5–9·5	0·5–1·5
" "	40–47	40–49	7·5–10	0·5–2·0
Solid "	9–25	56–76	5·5–9·5	0·5–4·0

As regards the chestnut extract imported into Great Britain and Ireland, the bulk is in liquid form ; the American product contains 29 per cent. of tannin and the French and Italian 27 per cent.

In the United States of America, owing to a widespread destruction of chestnut trees by blight, an investigation was undertaken to determine the possibility of utilising the stump wood, root wood and root bark. The root bark was found to contain over 30 per cent. of tannin and the root wood over 17 per cent.

Of the overseas countries of the British Empire, India and Burma are the only two where allied species of the chestnut grow in sufficient abundance to warrant their commercial exploitation.

India.—The chestnuts of India belong to the related genus *Castanopsis*. The species which have been investigated as to their possible utilisation as sources of tanning materials are *Castanopsis hystrix* A.DC., *C. tribuloides* A.DC. and *C. indica* A.DC. The last two are stated to grow on relatively low ground ; for instance in the Tista valley they occur at about 500 feet. These species are plentiful and one of them at least extends into the plains of Bengal. On examination *C. hystrix* was found to contain 11·6 per cent. of tannin in the twig-bark and 13 per cent. in mature stem bark ; *C. tribuloides* 13·6 per cent. and 6·9 per cent. respectively, and *C. indica* 11·8 per cent. in the mature bark. It is worthy of note that both the leaves and twig bark of *C. hystrix* contain the same amount of tannin. So far the investigation has been of a preliminary nature, but it has already shown that the mature bark of *C. hystrix* and the twig-bark of *C. tribuloides* are promising materials. It must be borne in mind in

connection with the commercial exploitation of these materials that the cost of transporting them from the hills to the rail-head would be comparatively heavy and might be sufficiently great to prevent their utilisation being remunerative. The bark and wood of these trees are being further investigated as materials for the manufacture of chestnut extract.

Burma.—The chestnuts of Burma have given more promising results than the Indian chestnuts. The two most prolific species found in Burma are *C. tribuloides* and *C. argyrophylla* Kurz, which grow abundantly and are widely distributed throughout the country. Of these the latter, which is not so plentiful as the former, furnishes bark which produces leather of a better colour than can be obtained with any other Burmese tanning bark. It is therefore recommended that this bark should be used for direct tannage for the production of sole and other heavy leathers. Samples of bole bark of this species have been found to contain as much as 18·2 per cent. of tannin while the bark of *C. tribuloides* contains from 10 to 19 per cent. Two varieties of *C. tribuloides* are found, the Namyas variety furnishing a richer bark (19 per cent. of tannin) than the Maymyo variety (13 per cent.). The wood of both *C. argyrophylla* and *C. tribuloides* (Maymyo variety) are comparatively rich in tannin, containing 12 and 16 per cent. respectively. As was noticed in the case of Burmese oaks, wood collected in the winter months is richer in tannin than that gathered in the summer.

Numerous experiments with Burmese chestnuts have been carried out at the Forest Research Station, Dehra Dun, and have shown that these trees give an extract richer in tannin than any of the European trees, while small-scale tanning trials have indicated the suitability of the bark and wood for the production of a good leather.

These investigations therefore demonstrate that the chestnuts of Burma could be used for the manufacture of extract, but whether the production of such extract in Burma is a commercial possibility has not yet been proved. But if a product of good quality could be made in that country at a cost which would allow a profit to the pro-

ducer and at the same time enable it to compete successfully with extract from other countries, a ready market would be found in the United Kingdom.

Cutch

"Cutch" is a name applied to solid tanning extracts, derived from several sources. Formerly it was used solely to designate the solid product obtained by concentrating an aqueous extract of the heart-wood of *Acacia Catechu* Willd., but at the present time, when cutch is mentioned in the United Kingdom, the solid tanning extract prepared from mangrove bark is usually meant. In the following account, however, the word "cutch" is used in its original sense.

Cutch is obtained from *Acacia Catechu* Willd., a tree, some 30 to 40 ft. in height, which grows in India and Burma. This tree also occurs in tropical East Africa, where, however, it is not used for the manufacture of cutch. Cutch may also be prepared from *A. Suma* Kurz and *A. Sundra* DC., which occur in South India.

For its preparation, the wood, preferably the heart-wood, of the tree is cut into small chips and boiled in water for about 12 hours in earthen pots. By the end of this time the water has been reduced in volume to about one-half. The liquor is then poured into a large cauldron and further boiled and stirred until it attains the consistency of syrup. It is now transferred to wooden frames lined with leaves and allowed to cool, when it hardens to a brick-like mass. In some districts, the liquid after being boiled for several hours is poured over a further supply of untreated chips and again boiled. The yield of cutch is from 3 to 10 per cent. of the weight of the wood. In the preparation of cutch by native methods, the chips used are so large that a considerable quantity of tannin remains in them after boiling. Experiments have been carried out with a view to demonstrating the possibility of increasing the yield of cutch. The results showed that the wood should be treated in the form of shavings, thereby trebling the yield; the quantity of water required is not more than ten times the weight of the wood and the shavings only need to be boiled for 30 minutes.

Two kinds of cutch are made in India, viz. "dark catechu" or "cutch," and "pale catechu" or "katha." The latter is used by the natives for chewing.

A. Catechu trees vary in value as a source of cutch, and in some cases are useless, e.g. certain trees growing in Bikaneer have been shown to be too poor in tannin for the purpose. The value of the trees also increases with the size.

Cutch of commerce is of a rusty brown or dull orange colour, of brittle texture and shiny fracture. It contains, on the average, 60 per cent. of tannin, together with a crystalline substance, catechin. The latter substance crystallises out from strong extracts on cooling and in many cases is removed in the preparation of cutch. As a tanning material cutch is not satisfactory as the leather produced is harsh and apt to give a yellow stain. It is used largely in tanning fishing nets and to a small extent as an astringent in medicine. Formerly large quantities were employed in dyeing, but it has now been replaced to a great extent by aniline dyes.

Burma is the chief country producing cutch. Twenty-five years ago it had a large trade in the material, but of recent years this trade has declined owing to cutch having been replaced in industry by cheaper materials, viz. mangrove extract and aniline dyes. There does not appear to be any great possibility of the trade expanding in the future owing to the restricted market for the product.

In Eastern Bengal and Assam there are numbers of *A. Catechu* trees, and should a demand arise for increased supplies of cutch, it would probably be possible to organise a remunerative industry in these Provinces.

Experiments were undertaken a few years ago in Madras which showed that *A. Sundra* yielded cutch of good quality. In consequence a firm sought concessions to exploit the trees, but their proposal was abandoned as the Forestry Department had not sufficient trees under their control to enable them to grant concessions over large enough areas to make the enterprise remunerative.

In the trade returns for India cutch and gambier are included together. The quantities of these materials produced in British India and exported during the years

Exports of Cutch and Gambier from British India

—	Quantity (cwts.).					Value (rupees).				
	1921–22.	1922–23.	1923–24.	1924–25.	1925–26.	1921–22.	1922–23.	1923–24.	1924–25.	1925–26.
United Kingdom	10,941	23,145	26,777	30,562	37,654	1,98,356	4,63,033	5,37,260	6,43,193	9,89,942
Germany	1,587	1,315	2,155	2,433	2,147	25,921	24,967	40,477	47,034	51,634
Netherlands	3,775	1,970	4,490	5,438	4,800	71,994	42,860	93,854	1,31,921	1,34,549
Belgium	150	550	300	450	1,220	3,700	10,894	5,155	9,251	31,574
France	2,150	5,853	6,106	7,271	5,827	35,612	1,00,474	1,15,660	1,51,892	1,43,215
Italy	—	—	550	2,053	1,375	—	—	11,813	43,947	32,986
Japan	4,752	2	301	1,521	1,104	1,02,013	55	5,247	22,697	31,559
United States of America	4,003	5,150	5,001	2,995	3,655	61,063	87,384	1,05,321	60,923	89,249
Total	29,653	39,328	46,858	53,565	59,827	5,62,094	7,62,236	9,52,686	11,40,148	15,82,652

1921-26 are shown in the table on p. 391, together with the chief countries to which they are shipped. Of the total exports Burma supplies by far the greatest quantity, Bengal coming next with considerably smaller amounts. It may be pointed out that these figures may be taken as actually applying to cutch only, as very little, if any, gambier is prepared in either India or Burma.

Gambier

Gambier is a solid extract prepared from the leafy twigs of *Uncaria Gambier* Roxb. (N.O. *Rubiaceæ*), a climbing shrub which is cultivated in the East Indies and Malaya. For its preparation leaves from the shrub (or preferably prunings) are warmed with a small quantity of water, the mixture being constantly stirred for two hours. The leafy material is then removed and the boiling continued. When the liquor has been concentrated to the desired consistency it is transferred to wooden frames where it is allowed to cool for an hour, being stirred the while. The liquor thickens on cooling and becomes yellow in colour and semi-solid. The mass is then cut into cubes, with sides about 1 to 2 in. long, and dried in the shade. The drying may also be effected in the sun or by artificial heat. The final product is known as " cube " gambier, and contains from 36 to 40 per cent. of tannin. It appears to be the practice in some quarters to add rice bran during the final stages of the concentration of the liquor, but this custom is to be deprecated.

U. Gambier is easily cultivated and after two years prunings may be made every six months. More frequent harvesting of the leafy material has a detrimental effect upon the life of the shrub. The material should be worked up as soon as possible after collection as the tannin content decreases on storage. Beside being prepared as " cube " gambier, the material is also marketed in the form of bales. For this grade the semi-solid mass of extract is not cut up into cubes and further dried, but is merely sold as it is, wrapped in grass mats and covered with sacking. The bales weigh about 60 lb. each. Gambier in bales contains more moisture than " cube " gambier, and is sold at a cheaper price, the respective percentages of tannin being

20 to 26 and 42 to 44. The custom in many modern factories is to market the product in block-form, packed in wooden boxes.

The manufacture of gambier is, particularly in the Dutch East Indies, carried on mainly by Chinese, and their product is often found to be adulterated. There are, however, some factories under European control and their products are generally more reliable. One firm, the Asahan Gambier Company, Zürich, turn out a first-class extract in the form of a yellowish-brown paste containing 23 per cent. of moisture and 58 per cent. of tannin. Gambier is sold by some firms with a guaranteed moisture content of 30 to 31 per cent., allowances being made to the purchaser if this figure is exceeded.

There is a large world demand for gambier as a tanning material, and also a considerable demand for it in the East for use as a masticatory. The result is that only part of the amount produced is exported. In Java, for instance, large quantities are manufactured, but further quantities have to be imported from the neighbouring islands to meet the local demand for chewing purposes.

It is estimated that the world demand for gambier is about 25,000 tons per annum. In the United Kingdom in 1926, 1,733 tons of gambier were imported. About two-thirds of this quantity came from the Straits Settlements, mostly in the form of bale gambier. The remaining one-third came almost entirely from the Dutch East Indies. Of the total imports in 1926, 324 tons were re-exported, chiefly to Belgium.

Gambier was formerly used in the United Kingdom for tanning calf skin and kips, but its use for this purpose gradually declined. When employed alone, the material gives a rather spongy leather, but when used in conjunction with other materials, such as wattle and myrobalans, it is suitable for both heavy and light leather.

Straits Settlements.—Of the countries of the British Empire, the Straits Settlements is the only one which exports any appreciable amount of gambier. The exports are given in the tables on pp. 395, 397. A large proportion of these exports may represent gambier imported from Sumatra.

The imports of bale and cube gambier from Sumatra into the Straits Settlements are given below. It cannot be definitely stated that these quantities were all re-exported, as no information is available as to the amount consumed locally.

Imports of Bale and Cube Gambier into Straits Settlements from Sumatra

—	Bale Gambier.		Cube Gambier.	
	Quantity (*Cwts*.)	Value (*Dollars*).	Quantity (*Cwts*.).	Value (*Dollars*).
1922	—	—	4,469	99,460
1923	99	1,063	4,344	99,476
1924	4,083	57,424	44,722	1,244,800
1925	7,316	99,289	42,022	1,057,495
1926	12,836	121,282	31,074	551,178

On the Malay Peninsula there are estimated to be 5,000 acres under cultivation with gambier in Trengganu, 1,000 acres in Johore and 2,300 acres in the Federated Malay States, mostly in Negri Sembilan. The cultivation has been recently extended owing to the high price now ruling for the product. The growing of gambier with pepper is recommended as the extracted leaves make a good manure for the latter. In many cases gambier is being cultivated as a catch crop on rubber and oil-palm estates. At one time there was an opinion prevalent that gambier was exhaustive to the soil and therefore could not be recommended as a catch crop, but further investigation has led to the conclusion that the economic cultivation of gambier does not ultimately diminish the fertility of the soil to a greater extent than most other catch crops.

Investigations were carried out with material grown on the Government Experimental Plantation, Serdang, to determine the factors which influence the quality of the product. These showed that for gambier of the best quality the cuttings should be used as fresh as possible. Extraction at temperatures above 80° C. causes decomposition of the tannin to take place. Concentration of the liquor at a low temperature gives a product of high quality and of good colour. The experiments also demonstrated

Imports of Gambier into United Kingdom

Countries whence consigned	Quantity (cwts)					Value (£)				
	1922	1923	1924	1925	1926	1922	1923	1924	1925	1926
Netherlands	1,411	—	194	226	114	2,620	—	537	810	125
Dutch Possessions in the Indian Seas	4,258	4,184	10,989	12,438	11,843	7,522	8,378	29,249	39,183	30,694
Turkey, Asiatic	—	—	—	283	—	—	—	—	1,538	—
China, exclusive of Hong Kong, Macao and leased territories	8,985	4,020	500	—	100	13,678	7,854	1,061	—	225
Other Foreign Countries	341	1,912	515	583	460	496	3,961	1,759	1,781	360
Straits Settlements and Dependencies (including Labuan)	68,869	43,798	24,435	27,484	21,604	113,388	92,948	67,015	88,082	46,074
Other British Countries	1,654	200	3,019	1,028	539	3,301	370	9,512	3,169	1,340
Total from Foreign Countries	14,995	10,116	12,198	13,530	12,517	24,316	20,193	32,606	43,312	31,404
Total from British Countries	70,523	43,998	27,454	28,512	22,143	116,689	93,318	76,527	91,251	47,414
Grand Total	85,518	54,114	39,652	42,042	34,660	141,005	113,511	109,133	134,563	78,818

Exports of Bale Gambier from Straits Settlements

Destination	Quantity (cwts)					Value (dollars)				
	1922	1923	1924	1925	1926	1922	1923	1924	1925	1926
United Kingdom	17,174	9,137	9 463	7,433	11,426	138,959	123,473	188,312	142,759	120,905
Belgium	5,004	4,539	6,127	10,714	6,046	39,439	55,678	121,492	184,947	68,839
France	4,424	2,615	3,991	6,429	3,999	39,357	35,786	84,542	112,338	44,205
Germany	1,536	1,007	3,311	1,465	1,194	12,551	12,016	72,060	30,168	11,022
United States of America	19,521	714	18,925	8,912	9,656	166,444	10,067	401,805	162,876	109,249
Other Countries	1,455	325	1,640	2,237	1,228	12,185	3,525	32,929	40,462	15,561
Total	49,114	18,337	43,457	37,190	33,549	408,935	240,545	901,140	673,550	367,781

that with simple apparatus as used by native cultivators, bale gambier of a uniform light mustard-yellow colour and almost completely soluble in water can be readily obtained.

British West Indies.—Attempts have been made to grow the gambier plant in the British West Indies, but although the climatic conditions in Trinidad, Dominica and British Guiana are favourable to its growth, the results have shown that the plant is not adapted for cultivation in the West Indies on a commercial scale.

British North Borneo.—*Uncaria Gambier* also grows in British North Borneo. Samples of the product prepared in this part of the Island some years ago were pronounced to be equal in quality to Singapore gambier. At the present time gambier is still being manufactured there, but the quantity exported is negligible.

Ceylon.—Trials were made years ago in Ceylon to determine whether gambier plants would grow in the Island. Plants were reared at Henaratgoda and grew rapidly, showing that *U. Gambier* could be propagated without much difficulty in this Colony.

The trade in gambier, while not capable of enormous extension, is of considerable value. The next few years will probably see an improvement in the quality of the product, and the price will doubtless be lowered on account of the increased planting that has recently taken place.

The cultivation as a catch crop on rubber or oil-palm estates is meeting with considerable success and a profitable opening is offered in this direction.

SUMACH

Sumach is derived from *Rhus Coriaria* L., a native of the European countries bordering the Mediterranean, the commercial supply being obtained almost entirely from plants cultivated in Sicily. Within the British Empire the only country producing sumach is Cyprus, but until recently its relation to the world supply was insignificant. In view of the great improvement effected in the quality of the Cyprus product during the last few years, that country now promises to become of importance as a source

Exports of Cube Gambier from Straits Settlements

Destination.	Quantity (cwts.).					Value (dollars).				
	1922.	1923.	1924.	1925.	1926.	1922.	1923.	1924.	1925.	1926.
United Kingdom	13,270	3,467	410	1,905	845	127,551	58,927	14,309	50,060	12,675
British India and Burma	36,904	38,481	37,690	39,399	35,880	447,399	772,345	983,194	798,911	504,494
Hong Kong	1,331	1,486	2,665	3,772	3,979	12,498	25,115	77,364	90,883	106,110
Belgium	200	1,970	—	163	—	1,852	27,188	—	4,099	—
France	5,834	6,334	—	20	—	61,226	91,739	—	500	—
Germany	5,126	4,882	7,375	5,486	3,355	60,826	83,219	235,120	134,755	47,457
Italy	1,361	2,670	300	741	504	15,859	39,418	9,792	18,052	7,623
French Indo-China	3,480	4,701	4,995	6,261	6,811	45,231	110,158	181,152	168,757	123,319
Japan	1,211	636	3,360	4,563	4,620	13,877	15,906	113,815	149,250	105,425
Java	11,980	9,857	15,831	4,824	530	163,634	209,180	597,251	161,972	14,100
Philippines and Sulu Archipelago	1,267	1,463	1,451	1,779	1,345	18,931	33,769	46,122	50,992	28,631
Siam and Siamese States	1,026	1,330	[illegible].5	821	980	17,175	28,068	25,672	23,657	21,127
United States of America	30,738	28,071	5,188	4,102	3,633	315,542	423,946	191,817	119,698	68,552
Other Countries	3,078	1,857	1,594	2,813	3,380	36,168	39,863	45,922	100,363	77,970
Total	116,806	107,205	81,734	76,649	65,865	1,337,769	1,958,841	2,521,530	1,851,949	1,117,483

of sumach, though the amount produced must for long remain relatively small as compared with the Italian output. The Sicilian product is stated to be produced from two distinct varieties of *R. Coriaria,* one of which, named "sommacco mascolino," is grown in the provinces of Girgenti and Trapani and contains from 30 to 32 per cent. of tannin, whilst the other, termed "sommacco femminello," obtained from the east of the Island, contains from 22 to 24 per cent. The product is exported chiefly in the form of a fine powder consisting of the ground leaves, leaf stalks, and thinner stems, and contains on an average 26 to 28 per cent. of tannin. Most of the sumach collected in the Island is forwarded to Palermo where it is ground three or four times in stone mills of the edge-runner type, and sifted after each operation from the coarser particles, which are afterwards re-ground. The product is then submitted to the important process of purification termed "ventilation," which consists of blowing the ground material by means of a fan into settling rooms, so that the heavier mineral impurities and particles of metallic iron (derived from the grinding machinery) remain behind. Ground sumach is shipped in bags of 75 kilos. The unground leaves are also exported, compressed in bales weighing usually from 250 to 300 kilos., and are largely employed for extract making.

Commercial sumach is frequently adulterated with the ground leaves of many other plants containing tannin, including other species of *Rhus.* The chief adulterant is *Pistacia Lentiscus* L., an evergreen tree which grows abundantly in Cyprus. Large quantities of the leaves of this tree, which contain 12 to 19 per cent. of tannin, are said to be annually exported to Palermo for this purpose.

Sumach finds extensive employment in the light leather industry, and belongs to the pyrogallol class of tannins. It furnishes the best known tannage for white or light-coloured soft and supple leathers, and is therefore very largely employed in the tanning of roans, skivers, moroccos, glove, bookbinding and upholstery leathers. The tannin of sumach is of a non-astringent character, consisting mainly of gallo-tannic acid ; the leather it produces does not darken on exposure to light, and has been shown to

be more resistant to ordinary gas fumes, and less liable to general decay than those furnished by any of the more modern tannages. Sumach is found very useful for brightening leathers of darker tannages, such as wattle and gambier, and as it affords white or nearly white leather, such leather is especially suitable for dyeing.

The world demand for sumach has been calculated at about 300,000 quintals (29,520 tons) per annum, the best markets being the United Kingdom, the United States, France and Germany. From the accompanying table (p. 400) of total imports of sumach into the United Kingdom for the five years 1922-26, it will be seen that British tanners are dependent for their supplies on foreign countries, principally Italy, the amount produced within the British Empire being at present of little importance. The phenomenal rise in the price of sumach during the last two years is stated to be due partly to decreased production, and partly to the consumption of reserve stocks and the lack of co-operation among producers.

Cyprus.—The Island of Cyprus affords the only commercial source of sumach within the British Empire. *Rhus Coriaria* is one of the principal indigenous native tanning materials of Cyprus, being found throughout the greater part of the Island, and flourishing especially among the vineyards on the slopes of the southern range of hills. A sample of dried leaves of Cyprus sumach examined some years ago at the Imperial Institute was found to contain 27 per cent. of tannin, the material thus comparing favourably with the Sicilian product (see this Bulletin, 1912, **10**, 45). For many years Cyprus has exported sumach to Egypt and Syria. Formerly the whole leaves only were exported, but since 1905, in view of the demand for the powdered material, stone mills have been erected in the Island for grinding the leaves. Small consignments of the ground leaves have from time to time reached this country, but as the process of "ventilation" was seldom properly conducted, the product was almost invariably contaminated with impurities, including particles of metallic iron, and was thus very inferior to Palermo sumach, and quite unsuitable for the United Kingdom

Total Imports of Sumach into the United Kingdom, 1922–26

Country whence consigned	1922 Cwts	1922 £	1923 Cwts	1923 £	1924 Cwts	1924 £	1925 Cwts	1925 £	1926 Cwts	1926 £
Cyprus	20	25	—	—	7	9	622	1,826	8,184	9,097
Italy	103,136	69,305	77,620	60,909	95,440	136,522	78,046	107,065	87,701	80,784
Spain	1,122	942	17,911	16,326	18,060	20,413	9,446	13,387	3,086	4,283
Tunis	—	—	3,937	1,600	—	—	6,103	3,490	2,000	1,100
Other Foreign Countries	189	497	1,248	703	311	425	1,039	745	527	332
Total	104,467	70,769	100,716	79,538	113,778	157,369	95,256	126,513	101,498	95,596

Re-exports of Sumach

Countries to which consigned	1922 Cwts	1922 £	1923 Cwts	1923 £	1924 Cwts	1924 £	1925 Cwts	1925 £	1926 Cwts	1926 £
British Empire	996	912	479	417	906	1,346	804	1,221	868	978
Foreign Countries	338	234	2,661	2,040	170	196	522	563	1,269	1,294
Total	1,334	1,146	3,140	2,457	1,076	1,542	1,326	1,784	2,137	2,272

Exports of Sumach from Cyprus, 1922–26

—	1922		1923		1924		1925		1926	
	Cwts	£	Cwts	£	Cwts	£	Cwts	£	Cwts	£
United Kingdom	40	10	—	—	—	—	420	244	8,155	5,467
Palestine	20	8	10	4	—	—	—	—	—	—
Egypt	2 162	779	2 284	983	1 255	414	1,075	410	1,791	795
Syria	3 604	1,250	7 695	2 870	5,396	1 992	1,519	512	1,352	527
Germany	—	—	—	—	1,983	661	6,135	2,662	2 030	897
France	—	—	—	—	—	—	329	108	—	—
Belgium	—	—	—	—	—	—	—	—	4,577	3,028
Italy	—	—	—	—	406	436	1,159	397	1,646	653
Greece	—	—	112	41	383	137	192	90	56	31
Roumania	—	—	—	—	257	107	739	345	147	65
Castellorizo	—	—	—	—	90	35	—	—	3	1
Dodekanesia	33	11	190	69	120	48	39	17	60	25
Turkey	117	51	89	34	142	48	120	43	33	15
United States	—	—	—	—	727	274	335	220	995	690
Total	5 976	2 109	10 380	4 001	10,759	4 152	12 062	5,048	20,845	12,190

market. Samples of some of this sumach ground in Cyprus, which were examined at the Imperial Institute, showed a tannin content of from 19 to 23 per cent., but furnished 9 to 14 per cent. of ash, and contained from 0·3 to 0·5 per cent. of metallic iron (see this BULLETIN, 1919, **17**, 534). It was made clear that this imperfectly ventilated material could never hope to find employment in the tanneries of this country, but that on the introduction of efficient ventilating machinery, Cyprus would be able to produce sumach equal in quality to the Sicilian product, and that a considerable export might then be established to the United Kingdom. Since 1923 a factory on modern lines has been erected in the Island with the result that Cyprus sumach is now considered fully equal to Sicilian sumach, and is finding a ready market in this country. The table given on p. 401 is the official record of exports of sumach from Cyprus during the five years 1922–26. It will be seen that Egypt and Syria, formerly the principal importers, now receive a comparatively small proportion of the total exports, and that last year (1926) the United Kingdom became the largest consumer.

Australia.—*Rhus Coriaria* was introduced many years ago into Australia, and is said to thrive well in the dry plains of the Wimmera district.

The leaves of several other species of *Rhus* are used for tanning under the name of sumach, but they usually contain an appreciably lower percentage of tannin, and furnish an inferior darker-coloured leather, and therefore have not attained the commercial importance of the Sicilian product. *R. Cotinus* L., a European species, known as Turkish or Venetian sumach, is also found in India, being indigenous to Western Himalaya and the Suliman Range. Throughout this area the leaves, bark and wood are used in dyeing and tanning. Reference is made in this BULLETIN (1916, **14**, 482) to an investigation of this Indian sumach by Puran Singh who stated that the leaves, when collected in the autumn after the rains, contained from 18 to 22 per cent. of tannin, and in one case

as much as 26 per cent. (31 per cent. expressed on the dry material). According to Watt the true sumach, *R. Coriaria*, is common in Afghanistan, and might easily be cultivated in India. *R. glabra* L., which is somewhat extensively cultivated in the United States, does not appear to be represented in the British Empire. The leaves of this species contain from about 21 to 28 per cent. of tannin, but furnish a darker-coloured leather than Sicilian sumach.

NOTES

New Zealand Hemp Grading Regulations.—Compulsory hemp grading was introduced into New Zealand in 1901. In 1908 the regulations were brought under the Products Export Act and were further modified in 1913 and 1923. New regulations have now been made which came into force on June 1, 1927. These were published in the New Zealand Government Gazette, No. 39, of June 9, 1927. The following points are of interest.

The grading scheme relates to hemp, tow, stripper-slips and stripper-tow, which are defined as follows: "Hemp" means the dressed fibre of the plant *Phormium tenax*, but does not include tow, stripper-tow or stripper-slips. "Tow" is the waste fibre produced during the process of scutching *Phormium tenax*. "Stripper-slips" means the waste fibre which has been produced during the process of stripping *Phormium tenax* and which has not been carded. "Stripper-tow" means the waste fibre which has been produced during the process of stripping *Phormium tenax*, and which has been carded.

The regulations provide for the size and weight of the bales, the tags which are attached to them, the registration of brands, the storage of Phormium products for grading, the standards of grading, the methods of grading procedure and the charges made, and the offences and penalties under the provisions of the regulations.

It is specified that the bales of hemp should be of a weight not exceeding 4 cwts., that they should be 4 ft. long, 2 ft. wide, and of optional depth. In the case of tow, stripper-slips and stripper-tow the bales should not exceed 3 cwts. The following are the standards which have been adopted for grading. The maximum number of points for allotment is as follows. For stripping 25 points; for scutching 25 points; for colour 25 points; for strength 25 points; making a total of 100. The

number of points required for each of the different grades are as follows :

A grade	(" Superior ")	from 90 to 100 points
B ,,	(" Fine ")	,, 80 to 89
CC	(" High-point good fair ")	75 to 79
C	(" Good fair ")	70 to 74
DD	(" High fair ")	65 to 69
D	(" Fair ")	60 to 64
E	(" Common ")	50 to 59
F	(" Rejected ")	under 50 points

No grader's certificate will be issued in respect of any hemp which in the grader's opinion has been so badly treated as to make it useless for the purpose of manufacture or for any other trade purposes.

The following standards have been appointed for tow :

No. 1 grade	from 80 to 100 points
,, 2 ,,	,, 60 to 79 ,,
,, 3 ,,	,, 40 to 59 ,,

No certificate will be issued in respect of any tow scoring less than 40 points.

The following are the standards for stripper-tow :

No. 1 grade	from 80 to 100 points
,, 2 ,,	,, 60 to 79 ,,
,, 3 ,,	,, 40 to 59 ,,

No certificate will be issued in respect of any stripper-tow scoring less than 40 points.

In grading stripper-slips the maximum points for allotment are : for freedom from dirt or rubbish 50 points ; for colour 25 points ; for strength 25 points, making a total of 100. The grades are determined thus :

No 1 grade	from 75 to 100 points
,, 2 ,,	,, 50 to 74 ,,

No certificate will be issued in respect of any stripper-slips scoring less than 50 points.

The Fig Industry in Asia Minor.—Under this title the Bombay Department of Agriculture have issued a *Bulletin* (No. 131 of 1926) compiled by Dr. G. S. Cheema, Horticulturist to the Government of Bombay, who visited Asia Minor in 1925 to study the cultivation and preparation of figs in the neighbourhood of Smyrna with a view to improving the methods employed in Western India. Dr. Cheema reports that some 20,000 to 30,000 tons of dried figs are brought to the packing houses annually for export, mainly from the Meander and Cayster valleys. In 1924 the yield of figs was estimated to be worth about £584,000.

Numerous types of fig are cultivated in the region, some of which have to be fertilised by the well-known method of "caprification," whilst others do not require this treatment. Certain varieties are not suitable for drying and are eaten locally in the fresh state. Most of the types are harvested in August; drying is carried out on floors or beds, the dried figs being sorted into two or three grades, put into baskets or sacks, and either stored in the vicinity or disposed of through small contractors, who send the fruit to the Aidin and Smyrna markets, where they are purchased for final grading and packing. The best brands of packed figs are stated to be shipped to the United Kingdom and the United States.

The Smyrna authorities enforce a set of useful hygienic regulations governing the conditions of work in the packing houses.

As regards methods of cultivation Dr. Cheema found little of special interest to record, though considerable difference in detail is observable as between various orchards. Pruning is not common as a rule, and no attention is paid to the question of disease; but care is taken to destroy weeds, and in cases where no inter-crops are grown the land is kept well cultivated. The soil of the fig-growing area is a very rich loam, containing considerable humus; though fairly stony, it appears to be capable of retaining moisture to an adequate degree, no irrigation being found necessary for the fig orchards, which in the Meander district extend from the banks of the river to the sloping hills which bound the valley; plantations being extensive up to about 300 feet above sea level.

Results of Enquiry into the Question of Exporting Salt Fish from Seychelles to Mauritius.—The following account of an enquiry carried out by Mr. P. R. Dupont, Director of Agriculture, Seychelles, has been furnished to the Imperial Institute by the Governor of that Colony.

In May last, 5 tons of salt fish, cured with Liverpool salt and packed in tin-lined boxes, were exported from Seychelles to Mauritius. As Mr. Dupont happened to be at that time in the latter Colony, he was able to investigate the way in which this consignment was disposed of, and to obtain first-hand knowledge of the conditions of the Mauritius market.

About 1,000 tons of salt fish are imported annually into Mauritius. The larger part of that quantity (600 tons) comes from South Africa; the remainder consists of cod (morue) from Europe (100 tons), the so-called

Arab fish from India and Aden (100 tons), dry salt fish from Madagascar and dependencies of Mauritius, such as Rodrigues, St. Brandon, etc. (200 tons); a few tons only are imported from Seychelles.

The whole market for salt fish in Port Louis is in the hands of Chinese traders who purchase wholesale consignments and distribute the article to their countrymen in the districts. The consignment referred to in the opening paragraph reached Mauritius just at the time when a consignment of South African snook and a large cargo of Rodrigues fish arrived. The article from Seychelles, which presented a new appearance and was hitherto unknown in the market, consequently had to be sold in competition with the consignments of the better-known kinds. Snook from South Africa is packed in gunny bags and has not an inviting appearance. It is dark-coloured and still retains the back-bone. The fish from Rodrigues is simply tied in bundles with twine in the same manner as that from Praslin which is received in Mahé (Seychelles). It is thus exposed to injury and cannot keep long. The fish from Rodrigues landed in Mr. Dupont's presence was well dried and presented a neat appearance, although it was still provided with heads, tails and bones. He found, however, that previous consignments received in the same way three months before, and still in some of the shops, had acquired the appearance of manure rather than of salt fish.

Statistics show that the snook from South Africa is not received regularly in Mauritius, and that the quantity imported is falling off owing, it appears, to the shoals of fish being less and less abundant near the South African coast. Only 17 tons were imported in 1926.

Cod from Europe which is shipped to Mauritius in tin-lined boxes, similar to those which had been adopted for the Seychelles salt fish, keeps a beautiful appearance and is sold in small quantity to well-to-do consumers at about Re.1 per pound.

Snook fetches anything between 15 cents to 40 cents per lb., while Rodrigues fish when quite fresh fetches a little higher price. After some time the latter fish becomes tainted, and is left practically unsold even below 15 cents per lb. Snook was being sold retail at only 15 cents per lb. when the Seychelles consignment was disposed of wholesale at 12 cents and retailed at 20 cents per lb.

The Seychelles fish was much admired by one and all, but owing to the competition with the better known articles, it was not disposed of easily, although it was

distributed throughout the districts. It sometimes takes a pink coloration, but this is not prejudicial to it, as cod from Europe is discoloured very often in the same way. Snook from South Africa is so dark that all pinkish discoloration is obliterated.

There is no doubt that packing Seychelles fish in tin-lined boxes involves large expenditure, but as there is no regular communication with Mauritius such careful packing is amply justified. If fish cured in Seychelles could reach Mauritius within a month, there would be no need of packing so carefully, but one should not lose sight of the danger of the fish being contaminated if it were packed in the same way as snook or Rodrigues fish are.

The appearance of the Seychelles fish is much better than that of snook, and they both have the same consistency, which is a matter of importance to Chinese traders. Snook is sold in small pieces, 2 in. square and even less, and the fish cannot be cut with a knife into these small pieces unless it is soft and pliable. The same way of selling very tiny pieces of fish to the poor might well be adopted with Seychelles fish. It is out of the question with Rodrigues or India fish, which is dry and crumbles to pieces under the knife.

It was clear to Mr. Dupont that there was a likelihood of a market in Mauritius for Seychelles fish on the condition that the exports should be small at first and gradually increased to meet the requirements of the market, but this can easily be done.

The only objection made was that red fish, like the varavara, croissant, etc., of Seychelles, are considered poisonous in Mauritius ; there is even a bye-law which interdicts the sale of these red fish in the central market. Nothing, however, prevents the Seychelles red fish (which is freely sold in Bourbon) from being sold outside the Port Louis market. In order, however, not to arouse suspicion, Mr. Dupont approached the authorities in Mauritius and drew their attention to the fact that about half of the fish caught in Seychelles waters consists of the red fish in question, and that it would be very useful for Seychelles if their well-known red fish could be exempt from the regulations of the Port Louis market. The question was submitted to His Excellency the Governor and to the Fisheries Board. The Chairman of that Board kindly consented to hold two meetings in September to consider the matter, and invited Mr. Dupont to be present. All details concerning the Seychelles varavara were submitted to them, and among the members of the Board

many pointed out that even in Mauritius varavara was not altogether poisonous, and that the custom of considering it so was due to the fact that fishermen, who receive a share in kind of their capture as bonus, are inclined to suggest that many red fish are poisonous in order to increase their bonus by receiving, in addition to their normal share, all the suspicious red fish interdicted from the market, which they hasten to consume themselves. However, this question of poisonous fish, as well as that of the pinkish discoloration of salt fish, was submitted by the Board to Dr. Barbeau, the Director of the Bacteriological Laboratory, with whom Mr. Dupont had several interviews. The reports of both Dr. Barbeau and of the Board will soon be forthcoming.

Mr. Dupont also submitted to the Director of Agriculture and to the Chairman of the Fisheries Board a sample of salted shark which had been cured in Seychelles a short time before his departure from the Colony. The flesh of this shark is practically free from oil, which is accumulated in the liver instead of being distributed throughout the flesh, as in the case of cod. The authorities in Mauritius were highly interested in the sample, which was of a good white colour, as they are using fish meal for poultry and other livestock, and the article which they receive from South Africa is very dark, being mostly whale flesh. As a result of his investigations, Mr. Dupont found that there is a large demand in Mauritius for shark flesh cured in the proper way, and especially if it is disintegrated, at 15 cents a lb. at least.

Roof Construction and Roofing Materials.—The following note has been kindly contributed by H. M. Ridge, M.E. (Freiberg), M.Inst.M.M., M.I.Chem.E.

The roof presents and has always presented the biggest difficulty in the construction of any permanent building. The only ancient structures which resisted the elements are the pyramids, which were covered with solid stone slabs ; even these were robbed by man of their original covering. No other really old buildings have been able to withstand the wind and weather for more than a short space of years, because of the roof becoming defective.

During the last hundred years there has become available a roofing material which is light in weight, obtainable at a reasonable price, easily fixed in place and resistant to corrosion. Sheet zinc was, I believe, first used in Belgium, and with remarkable results. In the industrial district round Liége, with a humid climate, there are numerous chemical and metallurgical works

burning coal, not particularly low in sulphur, and ordinary quality zinc sheets are extensively used for roofing ; they have an ultimate life of fully one hundred years under these adverse conditions, while the owners confidently reckon on not having to carry out any repairs at all for the first forty years. It is obvious that, under ordinary conditions, and where there are no chemical works fumes, such roofing sheets will last longer. New sheet zinc presents a bright metallic appearance, but soon dulls with the formation of a thin coating of zinc oxide which adheres firmly to the metal and protects it from further attack by the weather ; this film also preserves the sheet against any acid present in the atmosphere. In coastal districts, with sea-water spray carried forward into contact with the sheet, no trouble is experienced. As a further example, I would mention that many warehouses at the London Docks are roofed with sheet zinc because this material has been found most suitable and durable.

For the roof of the London Corn Exchange, sheet zinc which was put on about fifty years ago is still in good condition ; similarly part of the works of the London Zinc Mills, Ltd., was covered with sheet zinc, and after forty years promises a further long life.

Without myself having an axe to grind in drawing attention to the advantages of sheet zinc, I wish to give the whole facts. It should be supported over the whole surface ; this may be done on wood boards, on concrete or on any other material, but contact with another metal is to be avoided, so that zinc nails must be employed for fixing it. On the Continent of Europe, it is much used for covering the outside of damp walls, and is then fixed direct to the brick wall. It is easily bent to any required shape, and can be quickly repaired by soldering.

Ordinary quality zinc sheets are usually rolled from metal with about 98·5 per cent. to 99 per cent. zinc, the main impurity being lead and about 0·04 per cent. iron. As already stated such sheets show a good record in use ; but I wish particularly to draw attention to sheets rolled from high-grade metal with not less than 99·9 per cent. zinc and preferably more. As metal can be obtained for rolling with at least 99·92 per cent. zinc, this might be specified. The impurities should not be more than 0·04 per cent. iron and the balance lead, but the metal ought to be free from copper and cadmium.

High-grade zinc is almost immune from attack by any chemicals which can come into contact with roofing. Sheets rolled from this metal are soft and ductile, and should not be used in large sizes. They are usually

rolled 7 ft. by 3 ft. and 8 ft. by 3 ft.; but it is preferable to cut them to squares or diamonds, and it is only necessary to allow just enough lap to prevent water percolating or being drawn up by capillary action. High-grade metal was formerly produced either from ore free from lead, such as is mined in New Jersey, or by electrolysis of the chloride by Brunner Mond at Northwich, but it commanded a high price and was used for other purposes. During recent years, in consequence of the development of new metallurgical methods, increased supplies of high-grade metal have become available from Australia and Canada, so that it is now rolled in England into sheets. During the war considerable quantities of high-grade zinc were also produced in England. The price of high-grade zinc in ingots is now (end of July 1927) only £1 15*s*. to £2 per ton higher than virgin spelter, while that of the metal used for rolling ordinary quality zinc sheets is usually about midway between the two prices, so that the high-grade sheets should cost but little more than the ordinary quality.

Records over a long term of years are of course not yet available to prove the life obtainable from the use of high-grade zinc sheets, but their use is especially indicated where long life and absence of repairs are desired. Their adoption for roofing in tropical countries, coastal areas and industrial districts would be highly beneficial.

For roofing, zinc sheets of No. 12 or No. 14 zinc gauge are usually employed; these are 0·026 in. (0·66 mm.) and 0·032 in. (0·82 mm.) thick respectively. The weights per square yard of each gauge are 8·51 lb. (3·86 kg.) for No. 12 and 10·58 lb. (4·80 kg.) for No. 14 gauge. The present price is £37 per ton of 2,240 lb., delivered ex works, including packing.

For comparison, 24 gauge galvanised corrugated iron costs £14 to £14 15*s*. per ton in bundles, delivered at works port, and the weight per square yard is 11·11 lb. (5·04 kg.).

An Adjustable Dash Pot for Cement Testing.—During the carrying out, at the Imperial Institute, of investigations on Portland cement and on cement materials received from overseas, it has been found necessary to perform consistency tests involving the determination of the depth to which a weighted plunger will sink into a neat cement paste. For example, in the determination of "normal consistency" under the Argentine Government Specification (1914), it is required that the plunger shall be lowered into the paste, care being taken to support it

during the descent in order that the operation may be performed gently.

When testing under this specification was commenced at the cement testing laboratory of the Imperial Institute in 1915, it was observed that when the plunger was lowered into the paste by hand, there was a tendency on the part of the operator to impede its fall slightly as the 6 mm. end point was approached, and it appeared desirable to eliminate this personal factor and to secure uniformity in working by employing a mechanical device whereby the plunger should fall regularly and smoothly through the paste.

In *Engineering* of September 30, 1927, is described an adjustable dash pot, intended for attachment to the usual form of Vicat " needle " apparatus which has been designed at the Imperial Institute by Mr. A. T. Faircloth with the object of overcoming the above-mentioned error in testing and ensuring the rod of the Vicat " needle " being lowered under standard conditions.

This adjustable dash pot has been in use in the cement testing laboratory of the Imperial Institute for a considerable time, and has given every satisfaction.

RECENT RESEARCH ON EMPIRE PRODUCTS

A Record of Work conducted by Government Technical Departments Overseas

AGRICULTURE

SOUTHERN RHODESIA

The Acting Secretary, Department of Agriculture, has furnished the following reports by the chief Entomologist and the chief Chemist, respectively, for the first six months of 1927.

I. Report of the Entomological Division

(1) *Pests of Cotton*

Cotton Stainers (*Dysdercus spp.*).—The life history and bionomics of the common species have been studied and experiments carried out with a view to determining the part these insects play in the transmission of organisms causing boll rot and lint staining. The results of the latter are largely in accordance with the reports of investigators in other parts of the world, but observations indicate that forms of staining occur which are difficult

to associate with insect attack. This investigation is still incomplete and has been hampered by the general failure of the bolls of the available varieties of cotton throughout the colony to mature normally.

Cotton Jassid (*Chlorita fascialis*).—This insect has been studied in reference to methods of control and its relation to premature reddening of the foliage of the "Improved Bancroft" variety. Effective methods of control have not yet been discovered. With reference to premature reddening of the foliage, observations and experiments do not so far support the idea that this phenomenon is solely a result of Jassid attack, but the results are not regarded as conclusive and further work is necessary.

(2) *Pests of Tobacco*

Surface Beetles (*Tenebrionidæ*).—A number of experiments have been carried out in reference to methods of poisoning adult beetles of the genera *Gonocephalum*, *Emyon* and *Zophosis*, of which the first-named particularly proved very injurious to young tobacco plants early in the season. An interesting series of results were obtained and an improvement effected on previous methods. The latter consisted in utilising the attractive power of sugar as a basis for poisoned baits. The recent experiments have shown, however, that farinaceous foodstuffs such as bran, if kept moist under shelter, give very satisfactory results in the field and that *Zophosis*, which is not attracted to sugar, is also poisoned readily by this means.

"*Wireworms*" (*Tenebrionidæ*).—Similar experiments to the above have been carried out in reference to the adults of *Trachynotus* sp. and *Psammodes* spp., the larvæ of which are injurious to tobacco and are known as "wireworms" in this colony. The results were similarly satisfactory.

Attempts to poison *Trachynotus* larvæ in the soil met with some measure of success, but the economic possibilities of this procedure call for further investigation.

Tobacco leaf-miner (*Phtorimæa operculella*).—Experiments to determine the effect of arsenical sprays in checking this insect have resulted in considerable advantage to the sprayed plants, but complete protection has not been secured. Methods of rendering the covering of the leaves more complete are receiving attention.

Root Gallworm (*Heterodera radicicola*).—Some experiments have been carried out in reference to the use of calcium cyanide dust as a soil fumigant in tobacco seed-beds against this pest. The results so far have been inconclusive.

(3) *Pests of Maize*

Maize Weevil (*Calandra oryzæ*).—An investigation of the weevil problem as affecting the maize industry in this colony has been commenced.

(4) *Tsetse Fly* (*Glossina morsitans*)

Experimental operations, based on exclusion of game by fencing, are proceeding in the Lomagundi and Hartley districts with a view to relieving the position on certain outlying groups of farms affected by the proximity of tsetse fly. In the latter district the operations are still in the preliminary stage.

In the Lomagundi district, where the fencing was completed in December 1925, a restricted incidence of the disease during the past season gives cause for hope in reference to the ultimate success of the undertaking, but nothing in the nature of conclusions can yet be drawn.

An entomological officer recently proceeded to a selected site in the Lomagundi district with the object of establishing a field station for study of the bionomics of this insect in anticipation of future operations in this area.

II. Report of the Chemical Division

The research work carried out by the Chemical Division during the past six months has been confined entirely to manurial trials. The experiments at present in progress are detailed below, but with the exception of the citrus fertiliser trials, the results for the season 1926–27 are not yet available.

(1) *Citrus*

Citrus fertiliser trials are in progress on the British South Africa Co.'s estates at Mazoe and Umtali.

The object of these experiments, which were commenced in 1924, is to ascertain the effect on the health and productive capacity of citrus trees of applications of nitrogen, potash and phosphorus. Applications of these three plant foods are being applied separately and in various combinations to different plots. The results so far seem to indicate that as good results are obtained from dressings of a mixture of nitrogen and phosphorus as from a mixture of nitrogen, phosphorus and potash. The application of any one of these plant foods separately does not appear to be satisfactory. The evidence available is, however, not sufficiently conclusive to allow a definite statement on these points, and the fertiliser trials are, therefore, being continued.

(2) *Maize*

Experiments in soil treatment and manuring for maize production have been carried out at the Agricultural Experiment Station since 1919 and are being continued.

The results obtained up to 1925 have been recorded in *Bulletins* Nos. 467 and 568 issued by the Department of Agriculture, Salisbury.

Field trials to determine the relative efficiency of "Bone and superphosphate" mixture (one-third bone) and "Rock phosphate" on red dolerite soil for maize production were commenced last December, but the results are not yet available.

UGANDA

Mr. S. Simpson, Director of Agriculture, has furnished the following reports on experimental work carried out by his Department during the first six months of 1927.

(1) Serere Experimental Station.
(2) Bukalasa Experimental Station.
(3) Kampala Government Plantation.
(4) Botanic Gardens, Entebbe.
(5) Tobacco Experiments.

The work conducted at *Serere Experimental Station*, in addition to experiments on the cotton crop by the Cotton Botanist, to which reference is made below, comprised selection work on native food and other crops; variety trials with maize, millet (*Sorghum vulgare*) and simsim (*Sesamum indicum*); and cultural experiments on various cereal crops and ground-nuts.

At *Bukalasa Experimental Station* the work included rotation and other cultural experiments with cotton; a study of the various types of Robusta coffee; cultural and variety trials with cooking bananas; variety trials with sweet potatoes, ground-nuts, and mpindi (*Vigna catjang*); a comparison of the yielding capacity of green mpokya (*Phaseolus radiatus*) and black mpokya (*P. Mungo*); and selection experiments with simsim. In addition, a three-acre holding of which the main revenue-producing crop will be cotton, farmed by a native, under the control of the staff of the Government Plantation, was started early in the year; an approved rotation of crops is being followed and careful costings accounts will be kept.

The results of the above-mentioned experiments are not yet available.

At the *Government Plantation, Kampala*, work is being carried out on coffee, tea, cotton, plantains, Para rubber, cover crops, cassava, sweet potatoes, fibres and medicinal plants. Plots of *Coffea arabica*, growing under shade of

Grevillea robusta, were treated with lime, cow manure and artificial farmyard manure (produced from various local grasses treated with "adco"). The general growth and health of the trees were good, but, owing possibly to the heavy shade, flowering and fruiting were very poor and there was no noticeable difference between the control and treated plots. Different systems of pruning coffee are under trial, but it is not expected that any reliable information will be available until about 1929. As regards rubber, tapping is being conducted solely for the purpose of selecting good yielders. At present 25 trees, out of 700 being tapped, are under individual observation and the yields from these, according to the data so far recorded, vary from 5 to over 15 lb. of dry rubber per year. The results obtained from variety trials with cassava indicate that there is much scope for the improvement of this valuable native crop as regards yield. Certain of the cassava plants grown have shown a diseased condition of the foliage throughout their growth, and cultivation experiments have demonstrated that the disease is capable of reducing the yield of tubers enormously, so that care will have to be exercised to prevent its spreading. A few seedlings of *Hydnocarpus Wightiana*, planted out in September 1926, are showing slow growth, the present average height being 2 ft. Plants of *Picralima Klaineana*, put out in May 1925, continue to show slow progress, the average height being about 4 ft.

The report on experiments carried out at the *Botanic Gardens, Entebbe*, gives the detailed yields from tapping experiments with Para rubber for the first five months of the year and the crop records of plots of cocoa for May and June. It is not proposed to publish these figures in this BULLETIN, but they are available for consultation at the Imperial Institute by persons interested in the matter.

A summary of the report on cotton and the report on tobacco investigations is given below.

I. REPORT ON COTTON RESEARCH WORK

The selection experiments carried out at Serere were a complete failure; the numerous progeny rows and F_2 generations of crosses which were planted in 1926 produced only about 20 bolls between them in the harvest period. The extraordinary low yield was to a great extent due to a severe hailstorm which swept over the area on September 22, 1926. A comparison of the flowering curve of one strain with that of the same strain the previous year seemed to indicate that the total loss of crop could not be ascribed to the actual mechanical effect of the storm, but

when the incidence of pests and diseases is studied it is obvious that mechanical damage by the hail provided means of entry to disease especially, which caused premature decay of the crop. Adverse weather conditions during the growing season contributed further towards reducing the yield, a dry period from November to the middle of February causing premature opening of the bolls and decay of the plant and also inducing a bad Jassid attack.

These results show how greatly the success of selection work in Uganda is dependent on weather conditions and two such years in succession would probably result in the complete loss of valuable strains. To lessen this risk it is suggested that small rows of each strain should be grown at some sub-station where weather conditions are different from those obtaining at Serere.

As regards the results of the field experiments, any conclusions that can be drawn are applicable to that season only. For the second consecutive year early sown cotton has given increased yields, although these are hardly significant statistically.

The spacing experiment at Ngetta has for two years given an increase of yield in closer spacings. At Bukalasa increased yields for closer spacing were obtained, though these again are not significant.

In the yield tests of Nyasaland strains, for the second year in succession no differences in yield appeared at Serere, Kampala and Ngetta. This rather follows expectation, as these are all selections from the original strain introduced into this country and there is probably little chance of being lucky enough to select out a strain which gives a really big difference in yield.

Investigations are being made as to the effect of sulphuric acid on germination and the experiments this year are being extended to small plots in the field. If definite increase in germination percentage and in rapidity of germination is established, this method of seed treatment will be adopted for all experimental work and to aid in the rapid increase to bulk from small samples at Serere.

II. Report on Tobacco Experiments

The tobacco experiments carried out at Bulindi so far have been confined entirely to the heavy types of tobacco suitable for fire-curing and which can be grown and cured successfully by natives.

The varieties grown are " Piet Retief Swazie," the seed of which was obtained from the Department of Agriculture, Pretoria, and a heavy type of Virginian

tobacco, the seed of which came from the Government Plantation, Serere.

The seed was sown on February 10, and the young plants were put out in the field on April 21. Weather conditions during May and June were excellent. Growth was rapid and the plants were ready for topping at the end of June

The crop has been entirely free from any disease and, except for a slight attack by the stem borer while the plants were still in the seed-beds, no trouble has been experienced from insect pests, and the crop shows great promise of being successful.

MAURITIUS

Dr. H. Tempany, Director of Agriculture, has furnished summarised reports on research work in progress in his Department in respect of the following divisions Chemical, Botanical, Veterinary, Sugar Technology, Entomological, Agricultural and Statistical. The matters of more general interest are recorded below.

I. Chemical Division

The research work at present being done in the Chemical Division is chiefly concerned with Mauritius soils and manuring problems.

A soil survey has been undertaken and the analyses of the soils of the Moka district have now been completed, and it is expected that these results will shortly be published in the form of a *Bulletin*. The analyses performed include both chemical and physical determinations, the work having been recently extended to include the Keen and Racskowski figures, which have so far shown remarkable variations. As soon as these results are published a start will be made with the survey of the soils of the Flacq district.

The new official method of the Agricultural Education Association for the mechanical analysis of soils is being tried out, and is being compared with the method usually employed in this laboratory, i e the Osborne Beaker Method , this is necessary in view of the fact that the soils of Mauritius are of a highly ferruginous nature.

The chemical laboratory has in the past carried out many experiments regarding the action of manures in soils. Two *Bulletins* have already been published dealing with nitrogenous fertilisers, and the simultaneous application of organic manures, especially molasses. Investigations are now in hand with regard to phosphates and potash manures. One paper has already been published in the

Revue Agricole showing that very great reversion occurs in the soil to phosphatic manures after they have been in the soil for a period of two months. Repetitions of the experiments are being made, also an attempt to see if the phosphorus content of maize plants grown on the differently treated soils varies to any extent.

In regard to potassium manures, investigations are being carried out to see if reversion of a serious order may take place when they are applied to the soil. The analyses being made include the citric soluble potash and also the amount of potash replaceable by ammonium chloride by Hissenck's method.

A further investigation on phosphates in Mauritius soils is being started by the analysis of cane juice received from various estates to see if different canes from the same locality vary to any extent and also to see if the same canes from different localities vary.

Mauritius soils present many peculiar features, possibly due to the composition of the original rock. When time permits, samples of rock, of partly weathered rock, and of the residual soil overlying these rocks will be taken from different parts of the Island and analysed to follow the course of the weathering of the rock.

Investigations are also in hand on the calorific values of different bagasses, samples taken from mills and also fibres from canes crushed in the experimental mill having been tested.

II. Botanical Division

Research work on the following subjects is at present being carried out in the laboratories and at the experiment stations.

1. Mosaic disease of tobacco, tomato, capsicum and other members of the Solanaceæ.

Experiments are being carried on to study the transmission of this disease amongst these plants, and investigations are being made in the fields to determine whether plants growing spontaneously in or near tobacco plantations act as reservoirs of the virus.

2. Bud rot of the royal palm (*Oreodoxa regia*).
3. Rot of the crowns of coconut palms.
4. Stem diseases of the filao tree (*Casuarina equisetifolia*).

A survey is being done over the whole country (*a*) to study the conditions correlated with the outbreaks of the different diseases which affect the sugar cane, and (*b*) to determine the extent of the losses incurred through the prevalence of such diseases.

A similar survey is being made to study the ecology

and economic importance of (1) the more obnoxious weeds growing in cultivated fields, (2) the plants which are poisonous to cattle, and (3) the weeds which invade pasture lands.

III. Sugar Technological Division

A general investigation on the composition of molasses produced in the different factories of the Island is being made. The mineral composition and the proportion of the different sugars present are determined.

Research is made on the influence of the different methods of producing plantation white sugars on the amount of SO_2 present in the sugars obtained.

IV. Entomological Division

The research work at present carried out by this Division includes the following :

(*a*) Breeding of *Coccus tomentosus* imported from Ceylon on the species of prickly pear, *Opuntia tuna.*

(*b*) Crossing of *Opuntia monacantha* with *Opuntia tuna* in order to produce a hybrid on which *Coccus cacti* could be bred, with a view to its subsequent breeding on *Opuntia tuna.*

(*c*) Life history and breeding of parasites other than *Tiphia* on the *Phytalus* grubs.

(*d*) A general survey of the Coccidæ attacking economic plants in Mauritius.

(*e*) Investigations on the various entomophagous fungi, hymenoptera parasites and other predators attacking various species of Coccidæ.

(*f*) Insects attacking tobacco plantations or found on tobacco plants and their relation to the transmission of the mosaic disease.

(*g*) Application and economic value of various insecticides, such as Cyanogas and Vaporite, on the Phytalus larvæ and other harmful insects.

V. Agricultural Division

The research work in progress in this Division comprises trials on the breeding and selection of sugar cane varieties on two main and four branch stations, some thousands of varieties being concerned, and manurial experiments with canes at the Central Experiment Station and two branch stations ; trials with varieties of tobacco and investigations on their curing qualities, manurial experiments with tobacco, and selection of tobacco plants by pure line and progeny row methods with a view to the supply of seed ; and variety trials with pineapples, manioc, sweet potatoes, ground-nuts, yams, tannias, maize.

FORESTRY

MAURITIUS

Dr. P. Koenig, Director of Forests, has furnished the following statement on the research work carried out by his Department in the first six months of 1927.

In addition to usual measurements of sample plots and sample trees of both indigenous and exotic species, in view both of framing yield tables and of obtaining data for the volume and increment of woods, the following special work is under observation :

(1) *The Living Tree and Forest*

Indigenous Trees.—The natural regeneration of natte (*Imbricaria maxima*) and ebony (*Diospyros mauritianum*), the ruling species of the Mauritius forests, is under observation in view of elimination of factors that have so far been against it (weeds, struggle for life with numerous other surrounding species, animals, etc.).

Exotics.—From the several arboretums formed in different climates of the Colony, data have been recorded on the mode of growth of exotic species to help in the reafforestation scheme, and steps are taken for introducing some of them on a large scale.

Important plantations have been made recently of *Pinus longifolia* and *Pinus tæda*, that have been found to constitute improvements on the former selection of *Pinus sinensis* var. *Massoniana*, *Eucalyptus robusta* and *Eucalyptus teriticornis*. Rooted cuttings from the terminal shoots of branches of *Cryptomeria japonica* have been found an acceptable substitute for seedlings produced from seeds ordered from Japan.

An appreciable quantity of plants has recently been raised from locally obtained seeds of *Cupressus torulosa*, *Cupressus sempervirens*, *Callitris quadrivalvis*, etc., from trees standing in experimental plots.

The influence of felling season on the growth of coppice of *Tetranthera laurifolia* is also under observation.

(2) *Forest Products*

The study of an appropriate wood preservative, for local climatic conditions, has been in progress since May 1, 1923, when railway sleepers converted from locally grown eucalypts and pines and treated in England by the Powellising process, have been laid out on the line.

A small consignment of ebony will soon be completed for export to London, in order to test the present market for the produce.

The study of minor forest products (essential oils of eucalypts, allspice, clove, sandalwood, etc.), in connection with which interesting reports had been furnished by the Imperial Institute between the years 1909 to 1913, was stopped when the Forest Department's still was transferred, along with the gardens and museum, to the Department of Agriculture that had been constituted. It is proposed to make another effort in the next financial year in moving the Government for the necessary requisites to enable such work to be renewed.

MINERAL RESOURCES

FEDERATED MALAY STATES

The Acting Geologist of the Federated Malay States, in a communication to the Director of the Imperial Institute, deals with various researches carried out recently in the Geological Department, and encloses a copy of the Geologist's *Annual Report* for 1926 in which the results of these researches are reported on as follows. They relate to magnetic cassiterite, thorotungstite (a new mineral) and tin in granite.

Magnetic Cassiterite

The Chemist obtained some interesting results in connection with magnetic cassiterite, that is, tin ore containing so much iron in chemical combination that it is lifted by an electromagnet. That such cassiterite exists, has been known for a long time, but in view of the growing use of magnetic separators in dressing concentrates, miners would be well advised to have the magnetic portions examined in order to avoid possible loss. The Chemist reports as follows concerning a sample of tin ore submitted from a mine producing tin ore on a large scale:

"The average assay of the sample was 77·1 per cent. metallic tin; it contained 16·68 per cent. of magnetic ore and 83·32 per cent. non-magnetic. The magnetic ore assayed 77·6 per cent. metallic tin and the non-magnetic 77·0 per cent. metallic tin."

The higher assay value of the magnetic portion may be due to non-magnetic impurities, such as zircon, being left with the non-magnetic portion. Further work is being carried out on this subject.

Thorotungstite

In the *Annual Report* for 1921, p. 4, a mineral from Kramat Pulai Ltd. was described as hydrated tungstic

oxide. During 1926, Mr. Shenton had an opportunity of analysing better material and found that the mineral contains 16 per cent. of thoria and smaller quantities of other rare earths. This led to the preparation of a paper, which has been accepted by the *American Journal of Science*, describing the mineral as "thorotungstite," hitherto unknown. The main points about it are as follows:

"It is a decomposition product of a tungsten mineral and other minerals, that is formed occasionally in the sub-soil of the Kramat Pulai Ltd. mine above granite. It is essentially an hydrated oxide of tungsten and thorium with smaller amounts of ceria and zirconia. The best material shows very minute acicular crystals lining cavities. The crystals are orthorhombic, and show terminal faces. They are transparent, yellow, and show high refraction and double refraction. It has been found coating pieces of cassiterite."

Tin in Granite

Mr. Shenton also obtained some interesting results on the amount of tin present in normal porphyritic granite collected near the summit of the Taiping-Kuala Kangsar Pass, where there are no tin mines. Three large samples were collected by the Geologist, ground to pass a 30-mesh sieve and then concentrated by washing with water. The concentrates in all these cases were much the same and contained quartz, felspar, zircon (abundant), anatase, hornblende, tourmaline (scarce), biotite, sphene (abundant), arsenopyrite, pyrite and a little cassiterite. Chemical analysis gave the following results:

	No 1	No 2.	No. 3.
	Per cent.	*Per cent.*	*Per cent.*
Ratio of concentrate to granite . . .	0·041	0·026	0·067
Tin dioxide in concentrate . . .	0·84	0·25	0·13
Tin dioxide in granite . . .	0·00034	0·000065	0·000087

The tin dioxide occurs as cassiterite, which is a primary constituent of the granite, i.e. it crystallised with the other minerals direct from the magma.

UGANDA

In a communication to the Director of the Imperial Institute, Mr. E. J. Wayland, the Director of the Geological Survey of Uganda, states that the field work of the Survey has been somewhat restricted during the six months ending June 30, owing chiefly to the absence of officers on home leave. The prospecting of the alluvial gold deposits of the Kafu River and the geological survey of the Kafu

Basin, begun at the end of 1925, were, however, completed in May, when Mr. Hirst, the field officer concerned, returned to Headquarters to continue the work of the Petrologist and Chemist, who proceeded to England on leave in April.

The geological mapping carried out during 1925-26 by Mr. A. D. Combe in Kigezi showed clearly that over a great part of that district similar geological conditions obtained to those of known tin-bearing areas in Ankole (cf. this BULLETIN, 1927, **25**, 38). The knowledge thus obtained has borne fruit during the period under review in further discoveries of tin by prospectors acting on information made available by the Geological Survey. Promising discoveries have thus been made on the border of Ankole and Kigezi and as far west as Ruhuhuma, on the outskirts of the lava fields of Mufumbiro.

Drilling operations in connection with the search for coal in the Karroo beds of Entebbe Peninsula are temporarily suspended during the absence on leave of the Drilling Engineer, Mr. Gill. These operations have been, and will continue to be, guided by information obtained from prospect pits put down through the blanketing laterite at salient points ; and further work in this connection has extended our knowledge of the folding of the Karroo beds and of the Basement Schists-with-Granite on which they lie. Beds of carbonaceous and calcareous shales are prominent at depth in the borehole now in hand ; thin partings of coal also occur, and on the whole the succession is regarded as encouraging for further work.

Reverting to the examination of the Kafu alluvials, the extension of the work downstream beyond the length of river dealt with in the *Annual Report* for 1926, has definitely proved that no workable " lead " exists in any of the gravel deposits. The gold is widespread, and taken *in toto*, is in great quantity, but on no level has there been sufficient concentration. The scientific results, however, are of peculiar interest and importance ; on the one hand the high-level gravels, with the differential tilting movements of which they provide indisputable evidence, throw a great deal of light on the tectonic history of the country in the Pliocene and Pleistocene ; while on the other the study of the Karagwe-Ankolian sediments of Eastern Bunyoro and their relations to the Basement Schists and Granite, and the interesting structural features of the region, complete our knowledge of the outline of the geology of Bunyoro as a whole, so desirable in the study of the problems of the Western (Albertine) Rift Valley.

Headquarters Work.—Owing to the interest aroused of

late in the mineral potentialities of Uganda, and the consequent ever-increasing scale of prospecting activities, much of the Petrologist's time has been employed in making identifications, assays, etc., for members of the public. In addition to the usual gold and silver assays, the office has now taken in hand the assaying of tin.

Petrological work has been commenced on Mr. Combe's collection of the lavas of the Mufumbiro field, on the dolerites of Uganda and to some extent on the granites, *pari-passu* with the description and cataloguing of the rock slides in the Geological Survey collection.

The Mufumbiro lavas prove to be an eminently alkaline suite, consisting chiefly of leucite basanites and leucite tephrites, and most interesting conclusions are to be expected from an extended study and comparison with other East and Central African alkaline provinces.

The dolerites so far studied are olivine-free, usually enstatite-bearing and appear to be magmatically connected with certain enstatite-granites tentatively referred to in *Annual Reports* of this Survey as charnockites ; and it is highly probable that these enstatite rocks will be proved to belong to one phase of igneous activity manifested throughout the country.

TANGANYIKA

In a communication to the Director of the Imperial Institute, Dr. E. O. Teale, Director of the Geological Survey of Tanganyika Territory, states that the chief investigations have been with regard to water supply problems, in the solution of which probably lies the key to the successful and extended development of the resources of much of this Territory.

For the broad review of the question, much co-ordination of effort and research is required, for it is closely bound up with agricultural research with regard to soils, suitable crops, and with irrigation ; with veterinary research concerning the establishment of a sound cattle industry ; with research dealing with reclamation in connection with tsetse fly campaign ; with forestry in regard to water conservation as well as in other questions of settlement, native or European.

The research carried out has comprised field work in the investigation of conditions for surface conservation, the testing by boring and pit sinking in the search for underground supplies, and the supervising of an experimental construction for the conservation of sub-surface water in the dry sand rivers.

The following general conclusions, some of which are tentative, have so far been arrived at :

(i) That in a general way, over the driest areas, the rainfall, though scanty and uncertain, is sufficient to provide for some type of settlement and cultivation with suitable conservation methods.

(ii) That the annual water famine which many areas experience is due in many cases to neglect on the part of the natives in looking after their wells and rain ponds ; and that a more remote but nevertheless direct human influence is traceable in the persistent burning and clearing of forest on important mountains which formerly served useful and effective water conservators and regulators, but which have now ceased to function in this respect.

(iii) That sub-surface conservation of water in sand rivers, dry for most of the year, should be rendered possible in favourable places by the construction of submerged dams with suitable collecting sumps.

(iv) That over the vast portion of the central highlands, composed chiefly of granitic rocks, it is the shallow underground water supply that needs developing.

(v) That shallow hand-boring for exploratory purposes is very useful in many parts as a guide to the development of shallow wells, the construction of earth dams, masonry dams or excavations.

(vi) That deep boring is not to be recommended as a rule in the areas of the granitic rocks.

(vii) That deeper boring to search for artesian or sub-artesian water is worthy of testing in the fine volcanic ash beds, in some of the old filled-up lake beds and in the zone of sedimentary rocks in the coastal belts.

(viii) That a research unit is advisable, capable of carrying out constructive experiments of different types of water conservation, both surface and underground, in a small way first, under the very varied conditions of sub-structures which prevail. Particulars regarding the quality and quantity of water available are required, and investigations regarding simple but effective methods suitable for raising and distributing the water, especially for native and stock purposes.

The work thus outlined, and the conclusions reached, involving as they do a consideration of the basis of the development of the resources of the country, are of much importance ; and it is hoped, therefore, that there will be an opportunity of extending this investigation by carrying out such testing and experimenting as are necessary.

ABSTRACTS OF RECENTLY PUBLISHED LITERATURE ON AGRICULTURE AND FORESTRY

In this section a summary is given of the contents of the more important recently published papers and reports relating to tropical agriculture and forestry. It must be understood that the Imperial Institute accepts no responsibility for the opinions expressed in the papers and reports summarised.

FOODSTUFFS AND FODDERS

Cocoa.—The results of an investigation on " Economic Significance of Cacao Pod Diseases and Factors determining their Incidence and Control," by H. A. Dade, have been published in *Bulletin No. 6, Dept. Agric., Gold Coast.* The work was carried out in the Anyinam district, situated in the valley of the Birrim River, which is well adapted for cocoa cultivation on account of the humidity of the atmosphere and of the soil. The cocoa principally studied was that grown on native farms.

The severity of infection of black pod disease seems to depend on atmospheric humidity. Neither injury to pods caused by insects, provided the conditions of water-relation are well balanced, nor accumulations of empty husks appear to act as centres of infection. Incidence of the disease is to some extent due to diseased cushions. It may be reduced by control of atmospheric humidity to the minimum coincident with the amount of humidity required for the good cultivation of cocoa, and may be still further reduced by inducing an artificial habit in the host, and by the production of strains of Amelonado cocoa characterised by a modified morphology. The only parasitic fungus of importance in producing black pod disease is *Phytophthora Faberi* Maub.

Coffee.—A paper dealing with the treatment of coffee berries attacked by the coffee berry beetle (*Stephanoderes hampei* Ferr.) is given by J. G. J. A. Maas and K. B. Boedijn in No. 29 of the *Mededeelingen van het Algemeen Proefstation der A.V.R.O.S.* The best results in the destruction of the beetles were brought about by the use of high water-pressure (about 30 atmospheres), less satisfactory results being obtained by means of air-pressure. The use of turpentine vapour also proved effective, but experiments with formalin vapour gave unsatisfactory results in most cases. Naphthalene, camphor, and formalin tablets were also tried, but only the first of these proved at all efficient. The germinating power of

the coffee seed did not appear to be impaired in any of the experiments.

Tea.—" A Review of the Present Situation Regarding Tea Tortrix in Ceylon " is given in the *Tropical Agriculturist* (*Ceylon*) for June 1927, by S. Stuart Light, Entomologist, Tea Research Institute of Ceylon. Tortrix was more prevalent than ever in 1926, and especially in the tea-growing district of Maskeliya, which appears to be the chief breeding-centre of the pest. The control of tortrix pests falls under two headings, (1) active, when some definite and repeated action is involved, and (2) passive, when advantage is taken of some natural feature. Among the active methods of control are egg-mass collecting, trapping with Grevillea leaves, stripping the bushes, chemical treatment, and the attack of parasites and other natural enemies. Among the so-called passive methods is the principle of leaving nature to herself in the hope that natural agencies may in time bring about the suppression of the pest. The planting of shade trees and encouragement of birds are other methods of control which have received a great deal of attention. A flight break, i.e. a belt of trees across the line of flight of the tortrix moths, thereby impeding their flight and offering protection to the tea, has also been advocated. The author considers that the only measures of control holding out any hope of success are the employment of parasites, egg-mass collecting and the use of high shade combined, perhaps with the encouragement of birds. It is pointed out that if egg-collecting is to be successful there must be co-operation between the different estates.

Bananas.—An account of an investigation of the bunchy top disease of the banana is given by C. J. P. Magee, Assistant Plant Pathologist, University of Queensland, in *Bulletin* No. 30, issued by the Council for Scientific and Industrial Research, Commonwealth of Australia. Particulars are furnished of the known history of the disease in Australia, its economic effects, geographical distribution, etc.

The disease has very characteristic symptoms, the earliest and most definite being the presence of broken dark green streaks along the secondary veins of the laminæ, the midribs and petioles. Definite evidence has been secured that the disease can be transmitted from diseased to healthy plants by the banana aphis, *Pentalonia nigronervosa* Cql. On the other hand, artificial juice transfer inoculation and the contiguity of the roots and corms of diseased and healthy plants have not caused

transfer of the disease. A large number of measures, many of them of a drastic nature, are recommended for the control of the disease, such as the complete eradication and destruction of any infected stools. It is pointed out that no methods of protection are of value, and that there is no stock available which is resistant to, or immune from, the disease.

Dates.—"The Propagation of Date Palms from Offshoots" is dealt with by D. W. Albert in *Bulletin* No. 119, *University of Arizona, College of Agriculture, Agricultural Experimental Station.* Dates, unlike most other fruits, cannot be propagated true to type by cuttings, grafting or budding, but only by means of offshoots. An investigation was made to determine the effect of size, absence or presence of roots, spring and fall planting, and poor cutting on the growth of the offshoots. Great care was exercised in the preparation of the offshoots and in severing them from the parent plant, and steps were taken to prevent them from drying in the sun before being planted out. Other factors for the successful propagation of dates by this means are the size of the offshoots—those weighing from 5–10 lb. are too small to be very successful—a good root system, the preparation of the ground, and the depth of planting. Careful watering and mulching are essential. The plants should be protected during the winter either by wrapping them in burlap or by other similar means.

Subterranean Clover.—In a paper by William Davies, M.Sc., Welsh Plant Breeding Station, Aberystwyth (*J. Min. Agric.*, August 1927), some of the more important Australian and other literature dealing with the culture of this clover is reviewed, and the results obtained at the Plant Breeding Station in the course of the last two years are described.

Subterranean clover (*Trifolium subterraneum*), which derives its name from its characteristic habit of burying its seed, is an annual plant regarded in Australia as valuable both for pasturage and for its hay-producing qualities and also for its weed-suppressing capacity. It is said to have been originally introduced into Australia as an impurity in agricultural seeds, and is of special use in that country for cultivation on second-rate land. A necessary condition for its growth appears to be an annual rainfall of not less than 20 in.; in many areas dressings of superphosphate are essential to its success. In Wales it was found that for permanent grassland late June was the best time for sowing, whereas for late summer and

autumn keep an early sowing in March or April is best. In Australia, sowing in autumn is advised. Damage is sometimes done to the plant by the lucerne flea (*Smynthurus viridis*) and the pea mite (*Motophallus bicolor*). Two root diseases are reported from Florida, U.S.A.

Oils and Oil-seeds

Linseed.—" The Oil Content of Linseed with Comparisons of Tests for determining the Oil Content " is the title of *Dept. Bull. No.* 1471 (1927), *U.S. Dept. Agric.* There are three classes of linseed that occur in commerce in that country. North-western grown seed comprises that from North and South Dakota, Minnesota and Montana, and also includes Canadian-grown seed. South-western-grown seed is obtained from Kansas, Nebraska, Iowa and Eastern Colorado. Imported or foreign-grown seed comes from the Argentine, India and Manchuria. Seed from the flax-fibre industry is appearing in small but increasing quantities. A list is given of the oil-content of each of these classes of seed in each of the seasons from 1918 to 1924. From these figures it is seen that Argentine seed is richest in oil with an average for the seven years of 42·19 per cent. Canadian comes next with 41·43 per cent., whilst other seed of the north-western class contains 40·42 per cent. and the south-western 38·48 per cent. The seed from the flax-fibre industry gave an average figure of 39·46 per cent. over three seasons. Although these results show Argentine seed to be the richest in oil, yet the oil from such seed is considered to be slightly inferior to that of seed grown in the United States. The data published indicate that the oil contents of different consignments of seed of the same class often vary considerably. The conditions which cause this variation are discussed and it is shown that both climate and soil are determining factors. The amount of oil increases gradually as the point of production changes progressively from south to north. The variety of seed sown also influences the oil content of the progeny. Attempts to correlate the physical properties of the seed with the percentage of oil were unproductive. The weight of seed per bushel is no index of the oil content. The presence of damaged seed does not necessarily influence the amount of oil, but it does affect the quality of the oil. No relation exists between the colour and oil content. Seeds as they gradually increase in size show a gradual increase in the percentage of oil. These conclusions show that commercial grading of linseed, based entirely

on physical standards of quality, is of doubtful value as an index of the richness in oil. Details of an optical method for the rapid determination of the oil-content of linseed are given.

Oil Palm.—According to the *Ann. Rep. Agric. Dept., Nigeria*, 1926, work is being continued in Nigeria on small-scale extraction of palm oil by means of the cooker and screw-press (see this BULLETIN, 1927, **25**, 161). This process has been tested by daily use at Calabar and has been demonstrated at various places in that neighbourhood. The results obtained have been even more satisfactory than the earlier ones as regards the amount of oil extracted. At Calabar a yield of oil was obtained which was one and a half times that given by the native process. The advantage and efficiency of the new apparatus are appreciated by native extractors. The saving of fuel, water and time effected by the use of the cooker will probably not appeal to the native oil makers sufficiently to make them prepared to buy it at any price at which it could possibly be sold, even in large numbers. There is more likelihood of the screw-press being adopted, if it is offered at a low price such as might be possible if the presses could be made in hundreds. A smaller press worked by wooden levers, and which would be saleable more cheaply, is being tested.

Efforts are being made to start oil palm factories in Nigeria, and to make large plantations. The question of thinning, clearing up and planting a few acres of oil palm groves for demonstration purposes is also receiving attention.

Tung Oil.—*Bulletin No.* 12, 1927, of the Technological Museum, Sydney, New South Wales, entitled "Tung Oil (Chinese Wood Oil) from Australian-grown Trees of *Aleurites Fordii*," is issued with a view to inducing those interested in this useful paint and varnish oil to take up the experimental cultivation on a larger scale than has hitherto been attempted. In New South Wales there are about 1,000 of the trees. Samples of fruits grown in this State have been examined and the results have shown that tung oil, of a quality at least equal to that of the oil imported from China, can be obtained in good yields from trees cultivated in New South Wales. There are doubtless many other parts of the Commonwealth where the cultivation would also be successful. Further experiments are necessary to determine the precise cultural conditions and situations for the production of the highest grade of oil. Another important matter requiring

immediate investigation is the determination of the best conditions for the cultivation of the tree in order to secure a favourable yield of fruit. So far the trees examined, whilst yielding oil of the desired quality, have furnished fruit in comparatively small quantity.

ESSENTIAL OILS

Camphor.—The existence of camphor trees which do not yield camphor has long been known, but the reason for this phenomenon has never been satisfactorily explained. The whole subject of the variability of the camphor tree is reviewed by F. N. Howes in the *Kew Bulletin* (1927, No. 4, p. 157).

The tree known in Formosa as " Shô-Gyū," the wood of which furnishes about 2·5 per cent. of oil consisting of citronellol, geraniol, terpineol-4, eugenol and safrole, together with various terpenes but no camphor (see this BULLETIN, 1914, **12**, 484), was formerly regarded as *Cinnamomum Camphora* Nees, but has now been described as a new species, *C. Kanahirai* Hay.

The wood of the " Yu-Ju " tree, occurring in Southern Formosa, yields from about 1 to 5 per cent. of oil, consisting principally of cineole (see this BULLETIN, *loc. cit.*). This tree is identical botanically with *C. Camphora*.

Another Formosa tree indistinguishable botanically from *C. Camphora* is the " Shiu " tree, recognised with certainty only by the distinctive odour of the leaves and wood. The trees occur generally from the centre to the north of the Island, and are largely interspersed with the true camphor tree. The yield of oil varies from 2 to 9 per cent., according to the part of the tree used and the type of tree. The roots generally furnish twice as much oil as the trunk, the yield decreasing towards the branches, twigs and leaves. The oil from the leaves is stated to have the finest aroma. Although linalool is the chief constituent of most " Shiu " oil, which is now known on the United Kingdom market as " Ho " oil, some " Shiu " oils, particularly those obtained from the more southern limits of the "Shiu" areas, may contain more camphor than linalool.

The camphor trees in Japan, unlike those of Formosa, are said to be all camphor-bearing, but seeds from these Japanese trees when planted in Formosa appear to have produced both camphor and oil-yielding forms. Trees are indeed said to exist in Formosa which yield camphor from one side of the trunk and " Yu-Ju " oil from the other, and also trees yielding " Yu-Ju " oil on the one side and " Shiu " oil on the other. Trees yielding camphor and

other camphor trees furnishing only oil are found also in Mauritius (see this BULLETIN, 1916, **14**, 580), St. Vincent and Dominica.

After discussing these and other facts bearing on the subject, the author arrives at the conclusion that the variable behaviour of the camphor tree is partly controlled by climatic and environmental factors and partly by heredity, but that until further information and the results of more detailed experiment and investigation become available, the question must perforce remain an open one.

Ylang-Ylang Oil.—The production of ylang-ylang oil in French Colonies is the subject of an article appearing in *L'Agronomie Coloniale* (1927, **16**, 108). The chief French sources of this oil are Madagascar and the Comoro Islands, which in 1925 exported 128 quintals. A small quantity (35 quintals in 1925) is exported from Réunion. No oil appears to be now exported from Indo-China, which was at one time interested in its production. It is estimated that 3,500 hectares are devoted to the culture of this plant in Madagascar. In Réunion ylang-ylang is cultivated on well-drained, rich soils in low-lying situations. The plant cannot withstand prolonged dry periods, and to protect it from the wind and facilitate the gathering of the flowers, the trees are generally pollarded to a height of about 2·5 to 3 metres. The trees are mature when about four years old, and at ten years should furnish annually 10 kilos. of flowers. The fresh flowers yield about 2 per cent. of oil, but oil of good quality consists of about the first half of the distillate which is collected separately, the remainder being sold under the name of cananga oil. The latter name is also applied to the Java oil which generally consists of the whole distillate. The value of the best grade Réunion ylang-ylang oil per kilo. in 1926 was 700 francs, compared with 1,200 francs for Manila ylang-ylang, and 415 francs for Java cananga. The Madagascar ylang-ylang oil is appreciably lower in value than the Réunion oil, and averages about 270 francs per kilo.

FIBRES

Cotton

Nigeria.—In the *Annual Report of the Agric. Dept., Nigeria, for the year* 1926, it is stated that the amount of American cotton purchased for export in the Northern Provinces during the year ending March 31, 1926–27, was

15,856 bales (of 400 lb.) as compared with 37,243 bales during the preceding year. The causes of this decrease are discussed, and it is shown that several factors were concerned, among which are the following. The prices paid in 1926–27 were only $1\frac{5}{8}d.$–$1\frac{3}{4}d.$ per lb., as against $2\frac{1}{4}d.$ per lb. in 1925–26. Local hand-weaving has increased. The amount of cotton carried over at the end of the season was greater than usual, as was also the quantity purchased in petty trade and exported to French territory. It is considered that the greater part of the decrease is to be ascribed to the poor yield obtained, the cotton season being the most unfavourable that has occurred during the twenty-four years in which meteorological records have been compiled. It was found, however, that well-manured plots which were sown at the proper date yielded very little less than in normal years.

Three new ginneries were erected during the year at Gusau, Funtua and Karadua, and another is under construction at Mallamfashi.

The purchases in the Southern Provinces amounted to 2,760 bales as compared with 2,880 bales in the 1925–26 season. The cotton was of unusually low grade owing to heavy rain in January and February, when the crop was ripening. The work on the development of pure strains of Ishan cotton has been continued by the Government Botanist and promising results have been obtained (compare this BULLETIN, 1926, **24**, 697).

Uganda.—A report on the cotton industry of Uganda is given in the *Ann. Rep. Dept. Agric., Uganda Protectorate*, for the year ended December 31, 1926. The areas planted in each of the four provinces in 1925 and 1926 were as follows :

	1925. acres.	1926. acres.
Eastern Province	383,613	384,374
Buganda Province	197,500	173,000
Northern Province	25,641	31,735
Western Province	3,570	1,635
Total	610,324	590,744

The 1926–27 planting was carried out under favourable conditions, and the area included about 40,000 acres in the Eastern Province on which the N17 type was sown (see this BULLETIN, 1926, **24**, 49). Satisfactory growth took place at first, but later the yield was adversely affected by excessive rain, especially in the Eastern Province.

The exports of cotton from Uganda during 1925 and 1926 were as follows:

	1925.	1926.
Quantity, bales of 400 lb.	784,152	723,438
Value, £	4,685,992	3,051,791

The Cotton Ordinance, 1926, was passed in December, and came into force at the end of the year. This is of a comprehensive character and has been enacted with the object of securing and maintaining the production of cotton of a high quality, and in general to regulate and control the cotton industry of the Protectorate.

Improved Egyptian Cottons.—The following notes are extracted from papers by Mr. Victor Mosseri which have appeared in the *Official Report of the International Cotton Congress* held in Egypt in 1927 by the International Federation of Master Cotton Spinners' and Manufacturers' Associations.

The Ministry of Agriculture in Egypt have recently carried out experiments with the cottons known as No. 310, Nahda, Ashmouni Malaki and Zagora Malaki.

No. 310 is a cotton of the Super-Sakel type approaching Sea Island, which was isolated some years ago by Dr. Balls. This cotton is undoubtedly the finest, the most silky, the longest and the most resistant of all the cottons which have been produced in Egypt during the last three or four years. Its yield is only slightly less than that of the Domains Sakel, and many cultivators prefer to grow No. 310, as it realises higher prices than the former. The fibre is of attractive appearance, gives less spinning waste than that of the superior Sakels, and the yarns made from it are 1½–2 per cent. stronger than yarns made from Sakel.

The three other varieties mentioned above are the result of work conducted by Mr. Bolland who succeeded Dr. Balls as Botanist of the Ministry of Agriculture.

Nahda is an improved type of Assili which gives a higher yield per acre than the ordinary Assili, and fibre of a better quality. Comparative tests in three different districts showed that Nahda gives larger yields per feddan [1] than Domains Sakel, the average difference being about half a cantar.[2] Generally the difference is about 10 per cent. and the future of this cotton, which has been highly regarded by many spinners, especially on account of its length, strength and fineness, depends on the differences which would exist between the prices of Sakel or No. 310

[1] 1 feddan = 1·038 acres.
[2] 1 cantar = 99 lb. (ginned cotton).

and the brown cottons of which Nahda at present represents the best quality.

Ashmouni Malaki has been propagated in Upper Egypt on account of its high yield. In 1920–25 it gave an average yield of 8·29 cantars per feddan when grown at Fachn. Zagora Malaki has been found to be equally productive and to yield a longer, stronger and finer fibre than Ashmouni Malaki. The Ministry of Agriculture therefore propose to multiply Zagora Malaki for general cultivation in place of the present Uppers.

The Technical Service of the Royal Agricultural Society, Cairo, have made experiments with Sakel, No. 310, Casuli, Pillion, Assili, Zagora, Mazbout and Fathi. The most successful results, however, were obtained with the Maarad variety. Maarad cotton was obtained from Pima seed brought from the United States. Pima cotton, grown in Arizona and derived from Egyptian Mitafifi, has some undesirable characters, and it was considered that these could be remedied by growing the plant under the environmental conditions existing in Egypt and practising judicious selection. Experiments were commenced in 1918, and 150 individual selections were planted on the Bata Experimental Increase Farm in 1921. Further selections were made in 1922, 1923 and 1924. The strains were reduced in number in 1925 by selecting only those which gave the best yield combined with the most satisfactory gradings, best field reports, earliness, vegetative growth, regularity in height, types of plants, statistical records, etc., and these were distributed to large growers in the Delta. The area planted amounted to 700 feddans, and the average yield obtained was over 5 cantars per feddan. Maarad is a fine, long cotton which should be of great service to Egypt as it can be cultivated not only in the northern region, but also in the central and southern parts of the Delta, thus promoting the growth of fine cotton in the latter region and relieving considerably the production of Sakel. In 1926, Maarad cotton was cultivated in forty different localities in Lower Egypt and gave an average yield of 4½ cantars per feddan, which compares very favourably with that of Sakel, which in the same localities gave only 3 to 3½ cantars per feddan. The difficulty of attempting to propagate this cotton on a commercial scale and to maintain its quality was overcome by the formation of the Maarad Cotton Society in 1926, which has the right to dispose of the lint, for a certain period ; the control of the seed, however, remains directly under the supervision of the Technical Service of the Agricultural Society.

Sea-Island and Meade Cotton in the United States.—On account of the relatively high prices now being paid for long-stapled cotton, considerable interest has recently been evinced in the possibility of reviving the production of Sea-Island cotton, particularly in Georgia and Florida, and the United States Department of Agriculture have received many requests for seed. The supplies of seed which growers formerly obtained from the Sea-Islands of South Carolina are no longer available as the cultivation of this type of cotton has been entirely abandoned.

The causes of the decline of the Sea-Island cotton-growing industry and the possibility of resuscitating it or of replacing it by the cultivation of Meade cotton are discussed in a paper on "Sea-Island and Meade Cotton in the South-Eastern States," by O. S. Cook and C. B. Doyle, which has been published as *Dept. Circular* 414 (1927), *U.S. Dept. Agric.*

It is pointed out that, although the suspension of the Sea-Island industry is generally attributed to the boll weevil, production had been declining rapidly even before the arrival of that pest. This was due to the fact that for several years prices were below the cost of production and the farmers were therefore discouraged. The selection of superior strains was not continued, and the industry was already in imminent danger of extinction, when the appearance of the boll weevil prevented any attempts being made to improve the position.

The Sea-Island cotton plant is less susceptible than Upland cotton to boll weevil attack in the early part of the season, but is more liable to injury from the pest in the later stages of development. Comparison has been made between Sea-Island cotton and Meade cotton, an Upland type which produces a fibre equal to that of Sea-Island in length and fineness. Experiments carried out during the years 1923–26 in Southern Georgia and Northern Florida showed that under weevil conditions the Meade variety yields distinctly larger crops than Sea-Island. Efforts to establish the production of Meade cotton as a substitute for Sea-Island resulted in failure owing largely to the persistent planting of Sea-Island and short-stapled cotton in the same localities. The subsequent sale of the mixed, irregular fibre under the name of Meade cotton brought the variety into disrepute, and owing to the difficulties of marketing, the farmers became disinclined to plant it.

The full possibilities of Sea-Island cotton cannot be determined when it is planted in proximity to Upland cotton, and production in isolated communities is necessary to avoid weevil injury and also to maintain supplies of

pure seed. It is suggested that the method practised in several districts of Southern Mexico of growing Sea-Island cotton in alternate years and no cotton in the intervening years might obviate weevil attack.

The revival of the Sea-Island industry cannot be effected unless a system of production and marketing can be developed under which weevil injury is reduced, a uniform fibre produced, and full prices obtained. In the first place, it would be necessary to establish an adequate and regular supply of seed, and this could best be accomplished by the co-operation of growers in a community that would plant Sea-Island cotton exclusively. The United States Department of Agriculture is willing to co-operate with a constructive community undertaking to develop a better system of production of Sea-Island or Meade cotton and to determine the practical possibilities of improvements by community organisation.

Kapok

An investigation has been carried out by R. O. Bishop and G. L. Teik with a view to obtaining analytical data which could be used as criteria for comparing samples of kapok, and the results have been published in *Malayan Agric. Journ.* (1927, **15**, 97). Three Malayan samples were examined, two of which were obtained from Malay Kapongs situated along the Perak river, and the third from the Government Experimental Plantation, Serdang. Six samples were obtained from the Dutch East Indies, viz. prime Samarang, average Samarang, prime Porrong, prime Java, prime East Java and prime Madura. All these samples were submitted to chemical examination by the usual methods devised by Cross and Bevan, and to microscopical examination. Various buoyancy tests were also carried out. The results showed that the samples did not differ materially in their chemical or physical characteristics and that it was not possible to differentiate between them by buoyancy tests. In the course of the work the interesting observation was made that the treatment of kapok with a fatty solvent, such as light petroleum, does not affect its buoyancy.

Paper-Making Materials

American Woods.—In 1906 the Forest Service of the United States Department of Agriculture commenced a study of American woods with regard to their suitability for the manufacture of paper-pulp, and the investigation has since been carried on continuously.

An account of some of the work has been given by

Sidney D. Wells and John D. Rue in a monograph entitled "The Suitability of American Woods for Paper Pulp," which has been published as *Dept. Bull. No.* 1485 (1927), *U.S. Dept. Agric.*, and deals with all the available species which appear to offer possibilities in this direction.

No less that ninety-four species have been investigated and most of them have been tested by the soda, sulphate and sulphite processes. The object of the work was (1) to determine the suitability for paper-making of species growing in the natural forests, and (2) to ascertain the relative merits of species not in common use, but available to established pulp-mills, so that suitable species might be found to supplement the waning supplies of spruce.

The present situation of the United States with regard to pulp-wood is discussed and a table is given showing the pulp-wood consumption by species and by processes of manufacture in the United States in 1922. The percentages of the different woods consumed were as follows: spruces, 54·7; firs, 6·4; hemlocks, 16·1; poplars, 6·1; yellow poplar, 1·8; gums, 0·9; pines, 7·6; larches, 1·2; all other species, including bass wood, beech, birch, maple, chestnut, cotton wood, Douglas fir, white pine and willow, 5·2. The proportions of the wood treated by the different processes were: mechanical process, 26·9 per cent.; sulphite process, 49·9 per cent.; soda process, 14·2 per cent.; sulphate process, 9·0 per cent.

The methods used in the investigation are described, and particulars are given of the behaviour of the various woods when tested by the different processes, the yield of pulp obtained, and the relative facility with which the pulps are bleached.

The investigation has involved an enormous amount of work, and the report will be of great value for reference.

Caroá Fibre.—An investigation of Caroá fibre as a raw material for paper-making has been carried out by Merle B. Shaw and George W. Bicking, and the results have been published as *Technologic Paper No.* 340 (1927), *Bureau of Standards, U.S. Dept. Commerce.*

Caroá (*Neoglaziovia variegata*) is a plant of the *Bromeliaceæ* or pineapple family. It is indigenous to Eastern Brazil, being especially abundant in the Valley of the São Francisco River. The supply is at present sufficient to meet the needs of the natives, who employ the roughly prepared fibre for making coarse twines for the manufacture of nets, fishing lines and ropes for local use, but if an extensive supply were required for use on a large commercial scale cultivation would be necessary.

The fibre has now been shown to be very satisfactory for paper-making as it gives a large yield of pulp of good quality, and is particularly suitable for use with, or as a substitute for, rags or rope-cuttings. Estimates of production and cost indicate that its employment in this way would be quite practicable.

Paper-making trials were carried out by the process of digestion with caustic soda. When small quantities of caustic soda were employed a very strong paper was produced, which would be well adapted for the manufacture of bags and wrapping paper. With larger amounts of the alkali, a pulp was obtained which bleached easily to a good white and furnished paper which compared favourably with papers made from rag stock. The soda consumption and yield of pulp were satisfactory. On microscopical examination the ultimate fibres were found to have an average length of 4 mm. and an average diameter of 0·010 mm. ; the fibres therefore tend to felt well and give compactness and strength to the paper.

Full details of the experiments are given by the authors, including the equipment used and the procedure adopted.

Rubber

Hevea brasiliensis

Longevity of Hevea Trees.—Reference was made in this Bulletin (1926, **24**, 268) to experiments which were being conducted by F. G. Spring in Malaya to ascertain the yield of rubber from old trees, in view of a statement which had been made in the press that rubber trees in that country were now past their prime. The opinion was then expressed by Mr. Spring that the true cause of decreasing yields per acre, lies, not in the age of the trees, but in bad environmental conditions. The report on the experiments, which is published by Mr. Spring in the *Malayan Agricultural Journal* (1927, **15**, 208), fully confirms his earlier statement. The tests were carried out on eleven estates ; three plots of ten trees each were selected on each estate, every precaution being taken to obtain as far as possible trees of which the characteristics were the average for the particular estate. The highest yield obtained was in the neighbourhood of 1,000 lb. of rubber per acre annually. The estate in question was on flat coastal land, the soil being a heavy clay. The trees were planted in 1898, and an excellent drainage system was put in during 1906, but previous to this the drains were superficial. Satisfactory yields were also obtained from trees 24 to 28 years old on other estates

on well-drained flat areas. Next to such areas in point of yield come the undulating areas, more especially where there has been little erosion. The poorest yields from the old trees tested came from hill land which has suffered extensively from soil wash and from flat water-logged land badly drained.

It is pointed out that it is difficult to determine what the profitable commercial life of an average old estate will be, but Mr. Spring considers that there does not appear to be any cause for alarm provided that the present vitality of the tree is fairly good and precautions are taken to improve the environmental conditions where necessary. He is optimistic as regards a longer life for the younger generation of trees in Malaya, which are being grown under better conditions and more suitable treatment.

Manuring.—The results of an experiment carried out in Ceylon on the manuring of rubber trees with nitrate of soda are given in *Trop. Agric., Ceylon* (1927, **69**, 20). Ten two-acre blocks of trees were selected for the experiment. Five of the plots were manured with nitrate of soda at the rate of 5 cwts. per acre, in two applications of 2½ cwts. per acre each, the ground being forked over and the manure applied in the furrows. Two plots were forked only, and the remaining three were untreated. All the trees were tapped on a half circumference on alternate days, and the yield figures for each block in pounds of dry rubber per tapping were recorded from the beginning of the experiment, which was continued for a period of three years. The average yields of dry rubber per 100 trees per tapping over the whole period were as follows: manured plots, 3·737 lb.; forked control plots, 3·888 lb.; unforked control plots, 3·030 lb. It will be seen that the only real difference in yield is between the forked and the unforked control plots, for the manured plots (which were also forked), while showing a considerably higher yield than the unforked controls, are rather lower than the average of the forked controls. The results of the experiment seem to indicate, therefore, that nitrate of soda applied as a manure does not result in any definite increase in yield through its own direct action, but that the operation of forking has some stimulating effect on the trees which is reflected in an increase in yield of rubber.

Jelutong

An interesting account of Jelutong in Sarawak is given by T. Corson, Assistant Conservator of Forests, in the *Empire Forestry Journal* (1927, **6**, No. 1). Jelutong is

the Malay name for trees of the genus Dyera, and, as is well known, a " rubber " derived from certain species of these trees has long been an article of commerce. Three species of Dyera are recorded from Sarawak, viz. *Dyera Lowii* Hook. f., *D. borneensis* Baill., and *D. costulata* Hook. f. The first two species are confined to Borneo and Sumatra, while *D. costulata* occurs in the Malay Peninsula and in Sumatra. In the Peninsula, jelutong appears to be uncommon except on the lower hill lands, but in Sarawak the trees are sufficiently characteristic of the swamps of the lower river basins for such areas to be known as " jelutong swamps." The latter vary in width from ten to sixty miles, and mixed with the jelutong carry fine stands of useful timber trees, including species of Shorea, Hopea, Sindora and Dryobalanops.

The tapping of the jelutong in Sarawak is subject to regulations of the Forest Department. Only trees over 36 in. in girth may be tapped, and the cuts comprise a " mid-rib " channel from which side cuts form a " V " ; successive tappings take place at intervals of from seven to fifteen days. A worker taps twenty-five or thirty trees a day, collecting three or four gallons of latex. The methods of coagulation employed are designed to prevent as much as possible the disintegration of the jelutong which sets in when certain coagulants are used. The materials employed are commonly alum and gypsum which are usually added in small quantities to kerosene oil, the latter being used to prevent the disintegration ; the former use of copper sulphate or other poisonous substance as a coagulant is prohibited on account of the use of jelutong in the manufacture of confectionery. Sodium silicofluoride is recommended by the Agricultural Chemist, Straits Settlements and Federated Malay States, but jelutong which is destined for the United States may not be coagulated with this substance. Acetic acid is also employed. The coagulated product is refined by maceration and subsequent boiling until plastic, when it is kneaded and all solid impurities removed ; it is then pressed into blocks. Jelutong is used in the manufacture of chewing gum, and in mixtures for the production of cheap rubber goods. The timber of the Jelutong tree is white, fine-grained and soft ; it is an excellent material for drawing-boards, and is suitable for models and pattern making. There is no trade in the timber in Sarawak as felling of the trees is illegal.

Tobacco

Rhodesia.—According to a statement in the *Rhodesia Agricultural Journal* (1927, **24**, 787), the tobacco crop

produced in Southern Rhodesia during the season 1926–27 has proved noteworthy. The opening stages of the season were disappointing, the bulk of the crop being transplanted under difficulty, owing to lack of suitable rains at the time. Many growers were unable to plant out the whole of their crop until very late in the season, and these late plantings were severely damaged by frost before they reached maturity or could be harvested. During the growing period, too, the crop was subjected to several prolonged spells of drought.

In spite of the difficulties experienced by growers, however, a good crop was produced and is the largest yet harvested in the Colony. The quality of the leaf is stated to be good, and the average yield per acre promises to be the highest ever recorded in Southern Rhodesia. The number of growers and the acreage planted with tobacco also greatly exceed any previous figures recorded.

The number of Europeans on tobacco farms in 1926–27 amounted to 1,600, as compared with 388 in 1922–23, and a feature of the season has been the number of new growers and of prospective growers, who are undergoing tuition on the farms of old-established tobacco growers preparatory to taking up land of their own.

The total area under Virginia tobacco in Southern Rhodesia in 1926–27 was 32,614 acres, an increase of 19,454 acres over the figure for the previous year, and 24,856 acres over that for 1922–23. The approximate yield last season is given as 17,240,000 lb., but at the time the statement was prepared the whole crop had not been disposed of, and it was only possible to give a very rough estimate of the tobacco produced. The yield in 1922–23 was 2,540,942 lb.

The production of Turkish type of leaf, on the other hand, has fallen off during the last five years, the area in 1926–27 being 600 acres (less than half that of 1922–23), whilst the total yield fell from 269,839 lb. in the latter year to approximately 180,000 lb. last season.

The growing crop is stated to have been practically free from bacterial disease during the season, whilst insect pests gave little trouble. Mildew or white mould increased in many crops towards the end of the season, and several were severely affected by red rust (*Macrosporium longipes*).

It is pointed out that the exceptional results obtained last season may not be repeated in the following season, and growers are warned against planting a larger acreage than is warranted by the available capital, labour supply and building accommodation. An excessive acreage may result in the production of inferior leaf, with consequent

loss to the grower. It is emphasised that quality and not quantity should be the aim of the individual Rhodesian tobacco grower.

Tobacco Budworm.—A description of the life-history and methods of control of the tobacco budworm is given in *Farmers' Bull. No.* 1531, *U.S. Dept. Agric.*, 1927. This pest, the caterpillar of a moth (*Heliothis virescens* Fab.), causes severe damage in the Georgia-Florida tobacco-growing region of the United States, but further north it is usually only a minor pest. The eggs are laid by the moth on the under-side of the tobacco leaf and when the grubs hatch out they migrate to the bud of the plant, where they hide themselves and feed on the young growing leaves. Sometimes the mature foliage is eaten by the larger larvæ, but generally the damage to the bud leaves is much the more serious.

To prevent the young tobacco plants from being attacked, it is recommended that the seed-bed should be tightly covered with cloth so that the moths cannot obtain access to them. Any seedlings not required for planting should be destroyed as soon as the seed-beds are abandoned, so that they may not form a breeding place for the pest, and at the end of the harvesting season all tobacco stalks should be burnt. The larva pupates in the ground and many pupæ may be destroyed by ploughing the land in the late autumn or winter.

For the control of the caterpillars on the plants in the field, a poisoned bait, made by mixing 75 lb. of corn meal with 1 lb. of lead arsenate, is recommended. A small pinch of the mixture is placed by hand in the bud of each plant, the leaves being separated for the purpose if necessary; an excess must be avoided as it is liable to damage the young tender leaves in wet weather. For cigar wrapper and filler tobacco, the first application should be made as soon as the plants are set out in the field, and, until the tobacco is topped, at least two applications a week are necessary to protect the bud fully during normal growing weather; when growth is retarded by severe drought one application per week may be sufficient. In the case of bright or cigarette tobacco the number of applications necessary will vary from one season to another, but usually three to five applications at intervals of a week during the early part of the season will give sufficient protection.

Resins

Pinus longifolia Resin.—An illustrated article dealing with the turpentine and rosin industry in India appears in

Indian Forester (1927, 58, 379). According to the authors, A. J. Gibson and C. T. Mason, the industry had its inception some thirty years ago, when tapping the "chir" pine (*P. longifolia*)—the present commercial source of Indian turpentine and rosin—first took place. In 1910 the Punjab Government deputed a forest officer to study in France and America with the result that in 1914 turpentine and rosin were being produced commercially at Jallo. From then onwards progress has been rapid, and the local sale has expanded into a large export trade. In 1925 the sales of turpentine oil and rosin amounted to about 147,000 gallons and 45,000 maunds (1 maund = 82·3 lb.) respectively.

The "chir" pine is abundantly distributed at a height of 2,000 to 6,000 ft. along the lower slopes of the Himalayas, extending from the Kabul river on the west to the watershed of the Ganges on the east. Tapping is carried out by the Forest Department, who employ the French method, and adopt a conservative system whereby the resin capacity of the tree is utilised to a maximum with the minimum injury to the wood, and no encroachment is made on the capital wealth of the forests. Each blaze will yield 2·5 lb. to 5 lb. of resin in a season, and, on an average, eight trees must be tapped for a whole season in order to produce a gallon of the best turpentine oil. The resin, though liquid when collected, is a semi-solid mass by the time it reaches the factory. It is mixed with oil of turpentine from a previous distillation, and heated to 100° C., in order to render it liquid, and so enable it to pass readily through sieves to remove chips of bark, etc., which have escaped the filtration in the forests. The mixture is kept in decantation vats for fourteen hours; the fine dirt and water which have separated at the bottom of the vat are then drawn off, and the clear resin mixture is transferred to the still. The latter consists of a vertical column, about 15 ft. in length traversed by numerous copper tubes. These tubes are surrounded by steam at a pressure of 140 lb. per sq. in. The resin is drawn upward through the still by the aid of a vacuum produced by two steam jets working on the suction injected system. By the time the resin is drawn to the top of the still, the heat and vacuum have resolved it into turpentine vapour and molten rosin. The former is drawn on through a series of water-cooled fractionating columns, the fractions of highest boiling point condensing in the first of these, and the lighter fractions in the last. Meanwhile the molten rosin flowing from the top of the tubes into the still-head passes down a barometric column, where it meets jets of

steam which remove the last traces of the turpentine oil. It then passes through sieves into wooden vats, from which it is finally poured into casks where it slowly solidifies.

The crude turpentine oil from *P. longifolia* has the following percentage composition: α-pinene 25, β-pinene 10, carene 38, longifolene 20, loss and residue 7. The first grade turpentine oil is a rectified product, free from the objectionable high boiling sesquiterpene, longifolene. The rosin is graded according to the American standards familiar to the trade.

Tanning Materials

Sulphite Cellulose Extracts.—These extracts have been used for a number of years as filling agents in the manufacture of sole leather at a stage subsequent to the tannage of the hide.

A report, published by the U.S. Department of Commerce, Bureau of Standards, as *Technologic Paper No.* 339 (*Use of Sulphite Cellulose Extract as a Tanning Material*, by E. L. Wallace and R. C. Bowker), gives the results of an investigation carried out to ascertain whether sulphite cellulose extracts would be suitable for actual tannage in the manufacture of leather.

Sulphite cellulose extracts are prepared by neutralising the acid sulphite waste liquors from the manufacture of paper pulp, usually by means of a slight excess of dolomite lime, and removing the lime by the addition of the requisite amount of sulphuric acid. After filtration the residual liquor is concentrated to the desired density, about 30° B.

The laboratory examination carried out by the authors included analyses of a number of sulphite cellulose extracts and common commercial vegetable tanning materials, and small-scale tanning trials of the extracts, both alone and admixed with vegetable tanning materials. In addition pretannage experiments were carried out in an experimental tannery.

The tannin content of four sulphite cellulose extracts, as determined by the official method of the American Leather Chemists Association, was respectively 28·33, 28·79, 25·98 and 28·90 per cent., being similar to that of chestnut wood, oak bark and hemlock bark extracts, though lower than that of sulphited quebracho extract. These sulphite cellulose extracts, however, with the exception of the fourth sample, had the disadvantage of higher non-tannin contents than the natural vegetable tannin extracts, viz. 24·80, 24·21, 23·82 and 18·68 per cent.

Sulphite cellulose extracts are more acid than ordinary

vegetable tannin extracts, and may be blended with the latter to produce liquors of a desired acidity. It seems likely that sulphite cellulose extracts (which are very cheaply produced) may replace those more expensive materials now used to produce acidity in the tan liquors by fermentation.

In summarising their work, the authors state that the sulphite cellulose extracts contain a satisfactory amount of matter absorbable and firmly fixed by hide powder, comparing favourably with vegetable tanning extracts in this respect, and produce leather of a satisfactory colour. "These extracts may be blended with the ordinary vegetable extracts without loss of tannin content." "Leather of good quality can be produced either by pretanning with these extracts and finishing with the ordinary vegetable extracts or by tanning with a blend of these and vegetable extracts. The chemical, physical and ageing properties of the leather tanned with these materials compare favourably with those of leathers tanned without their use." The use of these extracts "would benefit the tanner by virtue of lowered production costs to the extent that they would be substituted for more costly materials and by decreasing the time required for tanning."

Forestry and Timbers

The Beech Forests of New Zealand.—The first part of an important monograph on the New Zealand Beech Forests by Dr. L. Cockayne has been issued as *Bulletin No.* 4 (1926) *of the New Zealand State Forest Service* under the title of "The Ecology of the Forests and Taxonomy of the Beeches." As is well known, the supplies of the excellent gymnosperm timbers of the Dominion (Kauri pine, rimu, totara, etc.) are rapidly decreasing, and at the present time the beech forests form by far the most important part of the forest resources of the country. Hitherto the ready availability of the softwoods has resulted in little attention being paid to the beeches as sources of timber, but there is no doubt that such excellent woods as are furnished by the New Zealand beeches cannot long remain out of commerce. In this connection the part played by the beech forests in the protection of mountain areas from denudation, and the conservation of water at the sources of the rivers, will need to be carefully borne in mind, while on the other hand it is satisfactory to note that there is evidence that the forests regenerate well and with fairly satisfactory rapidity. The position therefore clearly indicates that accurate knowledge of the beech forests is an essential desideratum.

Dr. Cockayne's investigations have aimed primarily at ascertaining whether the beech forests are of a type which can be profitably dealt with as a perpetual source of timber, and, if so, whether evidence can be obtained as to the best sylvicultural methods for dealing with the forests. Reliable information on these matters can only be obtained from a satisfactory knowledge of the ecology of the forests, involving a study of their composition and structure, the mutual relationships of the different members of the forest, and the life-history of the forest itself. The monograph therefore is to be issued in two parts, the first dealing with the scientific aspect of the question, the second (not yet published) being concerned more especially with the practical problem of sylviculture and related economic subjects.

All classes of the beech forest belong to the sub-antarctic rain-forest of the Dominion. As is well known, some confusion has hitherto existed in the nomenclature of New Zealand beeches in regard to both the trees and the timber, the latter being commonly known as "birch." This question was referred to in a report on New Zealand beech timber by the Imperial Institute Advisory Committee on Timbers (see this BULLETIN, 1921, **19**, 152). The classification and nomenclature now put forward by Dr. Cockayne will no doubt be accepted as standard. He recognises the following five species: silver beech, *Nothofagus Menziesii* (Hook. f.) Oerst.; red beech, *N. fusca* (Hook. f.) Oerst.; clinker beech, *N. truncata* (Col.) Cockayne; black beech, *N. Solandri* (Hook. f.) Oerst.; mountain beech, *N. cliffortioides* (Hook. f.) Oerst.: in addition there is a large number of hybrids, all the species except *N. Menziesii* being concerned. Red beech and clinker beech are the largest species, the trees reaching a height of 100 ft. and over, and up to 8 ft. in diameter; silver beech is nearly as tall, but rarely exceeds 5 ft. in diameter; black beech and mountain beech are smaller species, though the former may attain 80 ft. in height, while the latter is usually from 30 to 50 ft. high with a trunk less than 2 ft. in diameter. Probably all the species grow at approximately the same rate. The beech forest usually occupies much poorer soil than the typical rain forest, but the trees appear to be indifferent to the chemical composition of the soil except as regards an excess of salt or magnesia. Extremely wet soil is not desirable, and the relatively dry conditions of the tussock grassland country —including those imposed by the violent hot winds of those regions—are not favourable for natural establishment of the forest.

The section on the regeneration and reinstatement of the forests deals with probably the most important aspect of the subject. Regeneration is divided into (1) natural regeneration of the standing forest, (2) regeneration after removal of the trees for milling, (3) reinstatement after burning, and (4) reinstatement after the removal of grazing and browsing animals. The observations made on these important questions afford much ground for satisfaction. It was recognised that all the beech species require for their rapid development more light than is provided by the average forest canopy, and that development in full light outside the forest is at least three times as rapid as in a well-lit forest interior. Regeneration was in progress in every piece of mature forest visited by the author. After milling, the ground is generally occupied in a relatively short period by abundance of beech saplings, and forest in which the undergrowth has been completely destroyed by grazing and browsing animals rapidly produces new undergrowth when the latter are removed. There is, however, no reinstatement when the forest has been entirely destroyed by fire if no beech trees are in the immediate vicinity, but dense thickets of beech quickly appear if living beech trees here and there escape the flames. It was further observed that where taxads are also present in the forests, these when they fall are in many localities replaced by beech. An interesting relationship between beech and manuka (*Leptospermum scoparium* Forst.) is also recorded. At first the two species, which often develop together in the open, grow at the same rate, but in a few years the beech overtops the manuka, cuts off the light and completely destroys its competitor; the beech forest, it is stated, frequently commences in this manner.

The monograph is provided with maps and a number of admirable instructive photographs, including copies of the original plates illustrating the botanical characters of New Zealand beeches which appeared in *Icones Plantarum* (1844). It is "intended for the use of forestry students and others interested in forestry." With the appearance of the second part of the work such enquirers will have available a model handbook for their guidance and stimulation.

Canadian Timber.—Three *Tree Pamphlets* received from the Forestry Branch of the Department of the Interior, Ottawa, give admirable short accounts of interesting and important Canadian timber trees and the woods yielded by them. Pamphlet No. 10 deals with the eastern cedar

(*Thuja occidentalis*) which is found distributed from eastern Nova Scotia and Prince Edward Island westward through New Brunswick, southern Quebec, southern Ontario and Manitoba, but in no area meets the western cedar (*Thuja plicata*) of British Columbia. Large stands of the timber are still available, but supplies are being depleted. The timber, although light, soft and of no great strength, is very durable, and for this reason is extensively used for poles, sleepers, fence posts and rails, and shingles, in addition to many other uses.

Pamphlet No. 11 describes the western cedar of British Columbia (*Thuja plicata*) which sometimes forms pure stands, but is usually associated with other species, such as sitka spruce and yellow cypress in the north and Douglas fir and western hemlock in the south. This cedar is also strongly resistant to decay and more shingles are made from western cedar than from any other species. The timber is also used for a wide range of other purposes, e.g. ceilings, mouldings, interior decorative work, tanks, boats, outdoor furniture, etc.

Sitka spruce (*Picea sitchensis*) forms the subject of Pamphlet No. 12. This tree is confined to the Pacific Coast and adjacent islands, the range extending from Alaska to northern California. Supplies are relatively not abundant, the species forming less than 7 per cent. of the merchantable stand of timber in the coast region. As is well known, sitka spruce is pre-eminent as a timber for aircraft construction. It is also excellent for sounding boards of pianos, boats, oars, wagon-sides and ladders, and is a valuable source of paper pulp.

Trinidad Forests.—The Conservator of Forests, Trinidad and Tobago, strikes a new note in his report for 1926. The introduction to the report urges the need for developing a "forest conscience" in the Colony, especially as regards the necessity for re-afforestation, and emphasises the appeal by a striking diagram which has for its legend, "Avoid spending £4,000,000 on imports of timber every forty years and safeguard future supplies by investing in re-afforestation £200,000 during the next forty years." The report summarises the work done in regard to new forest reserves, demarcation and surveys, sowing and planting, and refers to the efforts made to collect botanical and wood specimens in accordance with the scheme for the examination and testing of Empire timbers by the Imperial Forestry Institute and the Forest Products Research Laboratory (acting in collaboration with the Imperial Institute). The Conservator suggests that the

scheme should be supplemented by local durability tests. Silvicultural research has been concerned mainly with the planting of cedar (*Cedrela mexicana* Roem.) which is considered to be the most valuable species indigenous to the Colony. Good drainage and effective weeding appear to be essential for the young plants and useful observations have been made regarding the relative growths of the species on different geological formations. Research in "utilisation" has been concerned with the seasoning work commenced during the previous year, but special attention has been paid to marketing problems. During the year over 50,000 ft. of seasoned timber was sold, the most important material being mora (*Dimorphandra Mora* Benth. and Hook.) which has been successfully used for tongued and grooved flooring; good results for this latter purpose have also been obtained with serette (*Byrsonima spicata* Rich.) and tapana (*Hieronyma caribæa* Urb.). Reference is made to the successful use of mahoe (*Sterculia caribæa* R. Br.) for box shoots.

Sand Dune Reclamation in Palestine.—An article by Tear, published in the *Empire Forestry Journal* (1927, 6, No. 1), records the progress made during the last three years in the work being carried out by the Forest Service in Palestine in regard to the fixing and reclamation of sand dunes. Probably the most important development, apart from the expanded operations of the Department, is that unofficial bodies are taking up dune reclamation as a practical procedure, a notable example being the proposals made to the Government by the Haifa Bay Development Company for the lease of the dunes between the towns of Acre and Haifa with a view to the improvement of the area for building purposes, afforestation, recreation grounds and parks. This area includes the Acre Experimental Station where much experience in methods of dealing with sand areas has been gained by the Forest Service, in whose hands the Station would remain for a number of years. The investigations carried out at this station since 1921 have resulted in the working out of methods for the preliminary fixation of the dunes preparatory to the second stage of reclamation, viz. the permanent fixation by means of afforestation. The author promises a detailed discussion of the subject in a later paper. The account of the planting work carried out during the past few years records a number of interesting facts. Considerable success has been attained by the use of *Artemisia monosperma* (a local plant) for planting on interior sand areas. The plant is readily propagated

by cuttings, and in addition to a natural regeneration by seed is readily propagated by artificial sowings. Seed has been sent for the purpose to Somaliland where similar reclamation problems are being taken in hand.

Experiments with a number of tree species have been carried out, but the results are not always promising; *Acacia cyanophylla* has given by far the best results.

BIBLIOGRAPHY

Comprising the more important reports, articles, etc., on plant and animal products, contained in publications received in the Library of the Imperial Institute during the three months September—November 1927.

The publications issued by the Governments of the Colonies and Protectorates can be obtained from or through the Crown Agents for the Colonies, 4, Millbank, Westminster, S.W.1. Applications for Dominion and Indian Government publications may be made to the Offices of the High Commissioners or Agents-General in London.

Agriculture

General

Commission Internationale d'Agriculture, XIIme Congrès International d'Agriculture, Warsaw, 21–24 June, 1925, Volumes 1–3. Pp 191, 611, 427, 9½ × 6½ (Warsaw. Siège du Comité d'Organisation, 30 rue Kopernik, Paris. Librairie Agricole de la Maison Rustique, 26 rue Jacob, VIe, 1927.)

Report of the Rothamsted Experimental Station, Harpenden, 1925–26, with the Supplement to the "Guide to the Experimental Plots" containing the Yields per Acre, etc Pp. 156, 9 × 6. (Harpenden: Secretary, Rothamsted Experimental Station, 1927) Price 2*s*. 6*d*.

Field Experiments at Rothamsted during 1925–26—I. By Sir John Russell. *Journ. Ministry Agric.* (1927, **34**, 600–612)

Administration Report of the Director of Agriculture, Ceylon, for 1926. Pp. 69, 13 × 8¼. (Colombo: Government Record Office, 1927.) Price Rs 1 45.

Guide to the Royal Botanic Gardens, Peradeniya. By T. H. Parsons. Pp. 31, 8½ × 5½. (Colombo. Government Printer, 1927.) Price R 1.

Report of the Botanical and Forestry Department, Hong Kong, for the Year 1926. Pp. 16, 9¾ × 6. (Hong Kong: Government Printers, 1927.)

Agricultural Research in the British Empire. VI—Agricultural Research in India. By Sir David T Chadwick. *Scottish Journ. Agric.* (1927, **10**, 321–325).

Annual Report of the Department of Agriculture, Assam, for the Year 1926-27 Pp. 38, 9¾ × 6¼. (Shillong: Assam Government Press, 1927) Price 8 annas or 1*s*.

Season and Crop Report of Burma, for the Year ending June 30, 1927. Pp. 53, 9¾ × 6¼. (Rangoon: Superintendent, Government Printing, 1927.) Price R.1 or 1*s*. 6*d*.

Annual Report of the Guntur Experiment Station, Madras, for the Year 1926–27. Pp. 16, 9¾ × 6. (Madras: Superintendent, Government Press, 1927.)

Report of Work of the Nandyal Experiment Station, Madras, for 1926–27. Pp. 16, 9¾ × 6. (Madras: Superintendent, Government Press, 1927.)

Annual Report of the Samalkota Experiment Station, Madras, for the Year 1926-27. Pp. 22, 9¾ × 6. (Madras: Superintendent Government Press, 1927.)

Annual Report of the Taliparamba Experiment Station and the Agricultural Middle School Farm, Madras, for the Year 1926–27. Pp. 15, 9¾ × 6. (Madras: Superintendent, Government Press, 1927.)

The Origin, Plan and Progress of the Sakrand Agricultural Research Station, Sind. By H. H. Mann. *Bull. No.* 145 *of* 1927, *Dept. Agric., Bombay*. Pp. 35, 9½ × 6. (Bombay: Superintendent, Government Printing, 1927.)

Annual Report on the Department of Agriculture, S.S. and F.M.S., for the Year 1926. Pp. 17, 13 × 8¼. (Kuala Lumpur: F. M. S. Government Press, 1927.)

La Main-d'œuvre Agricole en Indo-Malaisie. By Yves Henry. *Bull. Écon. Indochine* (1927, **30**, 137–208).

Annual Report of the Department of Agriculture, Colony of the Gambia, for the Period January 1, 1926, to March 31, 1927. Pp. 53, 13 × 8¼. (London: Crown Agents for the Colonies, 1927.) Price 5*s*.

Report of the Department of Agriculture, Tanganyika Territory, for the Year ending March 31, 1927. Pp. 46, 13 × 8. (London: Crown Agents for the Colonies, 1927.) Price 2*s*. 6*d*.

Annual Report of the Department of Agriculture, Uganda, for the Year ended December 31, 1926. Pp. 50, 13 × 8½. (Entebbe: Government Printer, 1927.) Price 4*s*.

Report of the Director, Dominion Experimental Farms, Department of Agriculture, Canada, for the Year ending March 31, 1927. Pp. 105, 9¾ × 6½. (Ottawa: King's Printer, 1927.)

Agricultural Statistics, British Columbia, 1926. *Bull. No.* 100, *Dept. Agric.* (*Stats. Branch*), *Brit. Columbia*. Pp. 44, 10 × 6½. (Victoria, B.C.: King's Printer, 1927.)

Report of the Department of Agriculture, Bermuda, for the Year 1926. Pp. 70, 13 × 8. (Hamilton, Bermuda: The Bermuda Press, Ltd., 1927.)

Report on the Agricultural Department, Montserrat, 1924–25 and 1925–26. Pp. 31, 13 × 8½. (West Indies: Imperial Commissioner of Agriculture, 1927.) Price 6*d*.

Annual Report, Department of Agriculture, New Zealand, 1926-27. Pp. 44, 13 × 8¼. (Wellington: Government Printer, 1927.) Price 1*s*.

Jahresberichte fur die Zeit vom 1 Juli 1917 bis 30 Juni 1924, Institut für angewandte Botanik, Hamburgische Botanische Staatsinstitute. Pp. 128, 10 × 7. (Hamburg: Lütcke & Wulff, 1927.)

Enquête sur le Matériel Agricole en Cochinchine en 1926. *Bull. Écon. Indochine* (1927, **30**, 259–295).

Verslag van den Directeur van het Algemeen Proefstation der A.V.R.O.S. 1 Juli 1926–30 Juni 1927. *Med. Alg. Proefsta., A.V.R.O.S., Alg. Ser. No.* 32. Pp. 40, 10¾ × 7½. (Medan: Varekamp & Co., 1927.)

Thirty-Fourth Annual Report, July 1, 1925 to June 30, 1926, Minnesota Agricultural Experiment Station. Pp. 55, 9 × 6. (St. Paul, Minnesota: State University, 1927.)

Agricultural Education in the Empire. Memorandum and Questionnaire on the Dissemination of Results of Scientific Research among Primary Producers. Pp. 4, 9¾ × 7¼. (London: Empire Marketing Board, 1927.)

Irrigation in the Empire. Memorandum and Questionnaire. By B. A. Keen. Pp. 8, 9½ × 7¼. (London: Empire Marketing Board, 1927.)

Spray Irrigation in the Eastern States. By G A Mitchell and F E Staebner *Farmers' Bull No* 1529, *U S Dept Agric* Pp 27, $9\frac{1}{4} \times 6$ (Washington, D C Government Printing Office, 1927) Price 5 cents

Irrigated Crop Rotations in Western Nebraska By C S Scofield and J A Holden *Tech Bull No* 2, *U S Dept Agric* Pp 26, $9\frac{1}{4} \times 5\frac{3}{4}$ (Washington, D C Government Printing Office, 1927) Price 5 cents

The Water Requirement of Plants at Akron, Colo By H L Shantz and L N Piemeisel *Journ Agric Res* (1927, **34**, 1093–1190)

Electro-Farming By R Borlase Matthews *Scottish Journ Agric* (1927, **10**, 271–279)

Two Important Leguminous Crops The Velvet Bean and the Dolichos Bean By C Mainwaring *Rhodesia Agric Journ* (1927, **21**, 858–865)

Weeds and Weed Seeds, Illustrated and Described *Bull No* 4, *New Series, Dept Agric, Canada* Pp 64, $9\frac{3}{4} \times 6\frac{1}{2}$ (Ottawa King's Printer, 1927)

The Bindweed By E G Schafer *Pop Bull No* 137, *Div of Farm Crops Washington Agric Exper Sta* Pp 19, 9×6 (Pullman, Washington State College 1927)

The Dwarf Marigold (*Schkuhria bonariensis* L) By K A Lansdell *Weeds of South Africa, No* 17 *Bull No* 17, *Dept Agric, Un S Afr* Pp 7, $9\frac{1}{2} \times 6$ (Pretoria Government Printing Office, 1927)

The Khaki Weed (*Alternanthera achyrantha* R Br) By K A Lansdell *Weeds of South Africa, No* 16 *Bull No* 16 *Dept Agric, Un S Afr* Pp 7, $9\frac{1}{2} \times 6$ (Pretoria Government Printing Office, 1927) Reprinted from *Journ Dept Agric*, 1926, September

The Biological Control of Prickly Pear Investigations of the Commonwealth Prickly Pear Board By A P Dodd *Journ Council for Sci and Indust Res, Australia* (1927, **1**, 48–54)

Sulphuric Acid as a Weed Spray By A Åslander *Journ Agric Res* (1927, **34**, 1065–1091)

The Soil

Soils of Tropical Africa Soil Survey of British Tropical Possessions By F J Martin *Trop Agric, W I* (1927, **4**, 165–168)

Considerations on Some Soil and Manurial Problems in Ceylon (II) By A W R Joachim *Trop Agric, Ceylon* (1927, **69**, 133–140)

A Reconnaissance Survey of Pumice Soils, Rotorua County V Mapping of County Boundary Completed By B C Aston *New Zealand Journ Agric* (1927 **35**, 96–101, *cont*)

Grouping of Soils on the Basis of Mechanical Analysis By R O E Davis and H H Bennett *Dept Circ No* 419, *U S Dept Agric* Pp 15, $9 \times 5\frac{3}{4}$ (Washington, D C Government Printing Office, 1927) Price 5 cents

The Effect of Varying Concentrations of Ammonia on the Nitrifying Power of the Soil By D V Bal *Agric Journ India* (1927, **22**, 298–300)

The Effect of Manuring a Crop on the Vegetative and Reproductive Capacity of the Seed By B Viswa Nath and M Suryanarayana With a Summary of the Results of certain Animal Nutrition Experiments carried out By R McCarrison *Mem Dept Agric, India, Chem Ser* (1927, **9**, 85–124)

Les engrais verts et plantes de couverture à la Station de Bên-Cat (Cochinchine) By G Oudot *Bull Écon Indochine* (1927, **30**, 578–584)

Field Experiments at Rothamsted during 1925-26 II Experiments with Basic Slag By Sir John Russell *Journ Ministry Agric* (1927, **34**, 727–733)

The Effect of Applications of Cyanamid on the Nitrate Content of Field Soils. By F. E. Allison. *Journ. Agric. Res.* (1927, **34**, 657–662).

The Degree of Response of Different Crops to Various Phosphorus Carriers. By B. L. Hartwell and S. C. Damon. *Bull.* 209, *Rhode Island Agric. Exper. Sta.* Pp. 19, 9 × 6. (Kingston, Rhode Island: State College, 1927.)

Insect Pests—General

Report of the Entomologist, Burma, for the Year ended June 30, 1926. Pp. 13, 9¾ × 6¼. (Rangoon: Superintendent, Government Printing, 1927.) Price As.4 (5*d*.).

The Life-History and Control of some Malayan Insects of Economic Importance. By G. H. Corbett and C. Dover. *Malayan Agric. Journ.* (1927, **15**, 239–270).

Notes on the Food-plants and Habits of some Southern Nigerian Insects. By F. D. Golding. *Bull. Entom. Res.* (1927, **18**, 95–100).

Pests of Economic Plants in Samoa and other Island Groups. By G. H. E. Hopkins. *Bull. Entom. Res.* (1927, **18**, 23–32).

Root Gallworm or Root Knot Eelworm (*Heterodera radicicola* Greef.). By R. W. Jack. *Rhodesia Agric. Journ.* (1927, **24**, 957–964).

Report on the Economic Importance of the Damage due to Termites or White Ants in Accra and Achimota on the Gold Coast and the Methods by which this Loss may be curtailed. By A. W. J. Pomeroy. *Sessional Paper X.* (1926-27) *Gold Coast.* Pp. 21 + 11 plates, 13 × 8. (Accra: Government Printer, 1927.) Price 2*s*.

Studies on Contact Insecticides. Part VI. The Insecticidal Action of the Fatty Acids, their Methyl Esters and Sodium and Ammonium Salts. By F. Tattersfield and C. T. Gimingham. *Reprint from Annals of Applied Biology* (1927, **14**, 331–358).

Physical Properties of Commercial Dusting and Spraying Materials. By L. R. Streeter. *Tech. Bull. No.* 125, *New York State Agric. Exper. Sta.* Pp. 12, 8¾ × 5¾. (Geneva, New York: State Agricultural Experiment Station, 1927.)

Fungoid Diseases—General

Plant Pathology. Studies in Europe and America. (6) American Research Institutions. The Citrus Experiment Station at Riverside, Cal., and the Hawaiian Sugar Planters' Association. By D. B. Adam. *Journ. Agric., Victoria* (1927, **25**, 540–545).

Factors affecting Certain Properties of the Mosaic Virus. By H. H. McKinney. *Journ. Agric. Res.* (1927, **35**, 1–12).

Quantitative and Purification Methods in Virus Studies. By H. H. McKinney. *Journ. Agric. Res.* (1927, **35**, 13–38).

Notes on two Fungicides: Sulphur and Bordeaux Mixture. By W. Goodwin and E. S. Salmon. *Journ. Ministry Agric.* (1927, **34**, 517–528).

Influence of Form and Proportion of Lime Used and of Method of Mixing on the Resulting Bordeaux Mixture. By E. B. Holland, C. O. Dunbar, and G. M. Gilligan. *Journ. Agric. Res.* (1927, **34**, 677–686).

Foodstuffs

Beverages

Economic Significance of Cacao Pod Diseases and Factors Determining their Incidence and Control. By H. A. Dade. *Bull. No.* 6, *Dept. Agric., Gold Coast.* Pp. 58, 9¾ × 6. (Accra: Government Printer, 1927.)

Coffee Growing in Kenya. By F. H. Sprott. *East Africa* (1927, **3**, No. 146, pp. 25–33).

Coffee Culture in Southern Rhodesia By G W Marshall *Rhodesia Agric Journ* (1927, **24**, 835–846)

The Coffee Industry of Cuba By W L Schurz *Tea and Coffee Tr. Journ* (1927, **53**, 1121–1125)

La culture du café dans l'Ituri Oriental By M van den Abeele *Bull Agric Congo Belge* (1927, **18**, 93–96)

Contribuição para o conhecimento da Braca do Café (*Stephanoderes hampei* (Ferr. 1867)) Modo de comportar-se e ser combatida em São Paulo, Brasil By M L de Oliveira Filho *Public No* 20, *Commissão de Estudo e Debellacão da Praga Cafëeira, Sec Agric, Comm e Obras Publicas* Pp 92 + 38 plates, 9¼ × 6¼ (São Paulo, 1927)

Report on Tea Culture in Assam for the Year 1926 Pp 5, 12¾ × 8¼. (Shillong Assam Government Press, 1927) Price 8 annas or 1*s*

Prospects of Tea Growing in Kenya By S Kaufman *East Africa* (1927, **3**, No 146, pp 57–59)

Tea Planting in Nyasaland Prospects in the Mlanje and Cholo Districts By Hon W Tait Bowie *East Africa* (1927, **3**, No 146, pp 47–51)

Growing Tea in Uganda Details of Cost of Production By Aucassin *East Africa* (1927, **3**, No 146, pp 51–57)

La Production du The au Tonkin By P Braemer *Bull Écon Indochine* (1927, **30**, 209–216)

Verslag over een Bezoek aan Britsch-Indie in Verband met het Helopeltis–Vraagstuk By A J Garretsen (with English summary) *Arch voor de Theecultuur in Ned -Indië* (1927, No 1, pp 7–63)

Tea Green Fly (*Empoasca flavescens* Fabr) By E A Andrews *Quart Journ, Sci Dept, Indian Tea Assoc* (1927, Part II, pp 61–68)

Some Observations on Violet Root Rot (*Sphaerostilbe repens* B and Br) By A C Tunstall *Quart Journ, Sci Dept, Indian Tea Assoc* (1927, Part II, pp 69–71)

De Zwarte Wortelschimmels van de Thee By A Steinmann (with English summary) *Arch voor de Theecultuur in Ned -Indië* (1927, No 1, pp 65–72)

Cereals

Cleaning Grain on Farms and in Country Elevators By R H Black and E G Boerneer *Farmers' Bull No* 1542, *U S Dept Agric* Pp 27, 9½ × 6 (Washington, D C Government Printing Office, 1927) Price 5 cents

Maize Growing in Kenya By W Evans *East Africa* (1927, **3**, No 146, pp 41–45)

The European Corn Borer By L Haseman *Circ No* 160, *Missouri Agric Exper Sta* Pp 8, 9 × 6 (Columbia, Missouri State University, 1927)

The Influence of Plant Injury and the Root Rot Diseases upon the Physical and Chemical Composition of Corn Grain By G H Dungan *Bull No* 284, *Illinois Agric Exper Sta* Pp 255–281, 9 × 6 (Urbana, Illinois State University, 1926)

Sampling for Rice Yield in Bihar and Orissa By J A Hubback *Bull No* 166 *Agric Res Inst, Pusa* Pp 23, 9½ × 7¼ (Calcutta Government of India Central Publication Branch, 1927) Price 7 annas or 8*d*

A Scheme of Classification of the Varieties of Rice found in Burma. By R A Beale *Bull No* 167, *Agric Res Inst, Pusa* Pp 14 + 4 plates, 9¾ × 7¼ (Calcutta Government of India Central Publication Branch, 1927) Price 6 annas or 8*d*

Annual Report of the Paddy Breeding Station, Aduturai, Madras for the Year 1926–27 Pp 21, 9¾ × 6 (Madras Superinte dent, Government Press, 1927)

Annual Report of the Paddy Breeding Station, Pattambi, Madras, for the Year 1926–27. Pp. 4, 9¾ × 6. (Madras: Superintendent, Government Press, 1927.)

Aménagement Agricole des Eaux en vue de la Culture des Rizières à Madagascar. By Reynier. *Riz et Riziculture* (1927, **2**, 169–201; 271–298).

La Riziculture en Cochinchine. By Tran Van Huu. *Riz et Riziculture* (1927, **2**, 255–270; *cont.*).

La Culture du Riz en Californie. By C.-F. Dunshee. *Riz et Riziculture* (1927, **2**, 245–254).

The Transplanting of Paddy. By L. Lord. *Trop. Agric., Ceylon* (1927, **69**, 3–6).

Une Enquête sur le Repiquage du Riz. By R. Laborde. *Riz et Riziculture* (1927, **2**, 299–310).

Composizione Chimica e Valore Alimentare dei Risi Italiani. By N. Novelli and L. Borasio. *Quaderni della Staz. Sperim. di Risicolt. Serie Prima, "Oriza Sativa," Anno* 1°, *N.* 2. Pp. 94, 11¼ × 7¾. (Vercelli: Direzione ed Amministrazione, 1927.) Price 10 lire.

Paddy Notes. I. Land Crabs in Paddy Fields. II. Tillering of Rice. By L. Lord. *Trop. Agric., Ceylon* (1927, **69**, 141–146).

Wheat Growing in Kenya. By Sir Rowland H. Biffen. *East Africa* (1927, **3**, No. 146, pp. 35–41).

Varieties of Wheat in New South Wales. By J. T. Pridham. *Farmers' Bull. No.* 158, *Dept. Agric., N.S.W.* Pp. 41, 9½ × 6. (Sydney: Government Printer, 1927.) Price 9*d.*

Wheat Varieties in South Australia. By R. C. Scott. *Journ. Dept. Agric., S. Australia* (1927, **31**, 145–149).

Testing of New Zealand-grown Wheats. Results for Years 1926 and 1927. By L. D Foster and F. J. A. Brogan. *New Zealand Journ. Agric.* (1927, **35**, 150–153).

Field Experiments with Wheat. Manurial Trials at Coonamble Experiment Farm, 1921–26. By W. M. Johns. *Agric. Gaz., N.S.W.* (1927, **38**, 665–666).

Dispersion of the Angoumois Grain Moth to Wheat Fields. By P. Simmons and G. W. Ellington. *Journ. Agric. Res.* (1927, **34**, 459–471).

Further Studies on Flag Smut of Wheat. By W. H. Tisdale, C. E. Leighty and B. Koehler. *Dept. Circ. No.* 424, *U.S. Dept. Agric.* Pp. 12, 9 × 5¾. (Washington, D.C.: Government Printing Office, 1927.) Price 5 cents.

Stinking-Smut of Wheat. V. Summary of Three Years' Experiments on Control, and Detailed Results for 1926–27 Season. By J. C. Neill. *New Zealand Journ. Agric.* (1927, **35**, 28–34).

Heat-Damaged Wheat. By D. A. Coleman and B. E. Rothger. *Tech. Bull. No.* 6, *U.S. Dept. Agric.* Pp. 31, 9¼ × 5¾. (Washington, D.C. Government Printing Office, 1927.) Price 10 cents.

Sugar

Sugar Growing in Kenya and Uganda. By "A Sugar Planter." *East Africa* (1927, **3**, No. 146, pp. 123–125).

Breeding Improved Sugarcanes for the Punjab. By Rao Sahib T. S. Venkatraman. *Agric. Journ. India* (1927, **22**, 293–297).

Sugarcane Mills and Small Power Crushers in the Bombay Presidency. By Rao Bahadur P. C. Patil. *Bull. No.* 139 *of* 1927, *Dept. Agric., Bombay.* Pp. 19, 9½ × 6. (Bombay: Superintendent of Government Printing, 1927) Price As. 6–6 or 9*d.*

Sugar: with Special Reference to the Work of the Imperial College of Tropical Agriculture, Trinidad. *Trop. Agric. W.I., Sugar Supp.* (1927, **4**, No. 9).

Notes on Insects Damaging Sugar Cane in Queensland By E Jarves *Bull No* 3, *Div Entom*, *Bur Sugar Exper Sta*, *Queensland* (2nd Edition, Revised) Pp 94, 9¾ × 6¼ (Brisbane Government Printer, 1927)

Yield Tests of Disease-Resistant Sugar Canes in Louisiana By R. D Rands and S F Sherwood *Dept Circ No* 418, *U.S Dept Agric.* Pp 20, 9 × 5¾ (Washington, D C Government Printing Office, 1927) Price 5 cents

Top Rot in Sugar-Cane By E J F Wood *Queensland Agric Journ* (1927, **28**, 208–211)

The Poppleton (Yorks) Beet Sugar Factory a Description of the Factory Process *Journ Ministry Agric* (1927, **34**, 612–617)

Sugar Beet Experiments in Ireland, 1926 *Journ Dept Lands and Agric*, *Ireland* (1927, **27**, 39–69), (also published as a separate leaflet, obtainable free of charge from the Secretary, Department of Agriculture, Dublin)

Sugar Beet in the North of Scotland By W J Grant *Scottish Journ Agric* (1927, **10**, 305–314)

Poeciloscytus cognatus, Fieb (Hemiptera, Miridæ) as a serious pest of sugar-beets By N S Dekhtiarev *Bull Entom Res* (1927, **18**, 1–3)

Root Crops

Potato Culture By G J Bosman and D Moses *Bull No* 26 (*L*), *Dept Agric*, *Un S Afr* Pp 8, 9½ × 6 (Pretoria Government Printing Office, 1927)

Origin and Distribution of the Commercial Potato Crop By J W Strowbridge *Tech Bull No* 7, *U S Dept Agric* Pp 60, 9 × 5¾ (Washington, D C Government Printing Office, 1927) Price 15 cents

Mottle Necrosis of Sweet Potatoes By L L Harter and W A Whitney *Journ Agric Res* (1927, **34**, 893–914)

Relation of Soil Temperature and Soil Moisture to the Infection of Sweet Potatoes by the Stem-Rot Organisms By L L Harter and W A Whitney *Journ Agric Res* (1927, **34**, 435–441)

The Comparative Susceptibility of Sweet-Potato Varieties to Stem Rot By L L Harter and W A Whitney *Journ Agric Res* (1927, **34**, 915–919)

Fruits

Fruit Growing in the Empire (I) Memorandum upon the Standardisation of Horticultural Material by Selection and Vegetative Propagation, with Special Reference to Root-stock Influence By R G Hatton Pp 19, 9¾ × 7¼ (London Empire Marketing Board, 1927)

Fruit Growing in the Empire (II) Memorandum upon Fruit Quality Its Determination by Nutritional Conditions and its Relation to Marketing Problems By B T P Barker Pp 12, 9¾ × 7¼. (London Empire Marketing Board, 1927)

Report on Fruit Investigation during the Canadian Season 1926-27 *Special Report No* 1, *Empire Marketing Board* Pp 15, 9¾ × 7½ (London Empire Marketing Board, 1927)

An Economic Study of Small-fruit Farming in British Columbia. By G H Harris *Bull No* 101, *Dept Agric*, *Brit Columbia* Pp 39, 10 × 6¾ (Victoria, B C King's Printer, 1927)

Cool Storage Investigations, Season 1926 By L W Tiller *Bull No* 6, *N S*, *Chem and Agric Dept*, *Cawthron Inst*, *Nelson, New Zealand* Pp 16, 9½ × 6 (Nelson, N Z R W Stiles and Co, 1927)

Apple Breeding at the University of Illinois By C S Crandall *Bull No* 275, *Illinois Agric Exper Sta* Pp 341–600, 9¾ × 6 (Urbana, Illinois State University, 1926)

Controlling the Epidemic of Apple Worms. By L. Haseman and K. C. Sullivan. *Bull. No.* 250, *Missouri Agric. Exper. Sta.* Pp. 16, 9 × 6. (Columbia, Missouri: State University, 1927.)

Brown Rot of Apples: the Need for Careful Picking and Sorting. By H. Wormald. *Journ. Ministry Agric.* (1927, **34**, 552–554).

A Canker of Apple and Pear Trees Caused by *Glutinium macrosporum*, n.sp. By S. M. Zeller. *Journ. Agric. Res.* (1927, **34**, 489–496).

Apple Scab. By J. F. Hockey. *Pamphlet No.* 82, *New Series, Div. Botany, Dom. Exp. Farms, Dept. Agric., Canada.* Pp. 7, 9¾ × 6½. (Ottawa: King's Printer, 1927.)

"Shot-hole" of Apricots (*Coryneum beijerinckii* Oud.). By S. Fish and A. A. Hammond. *Journ. Agric., Victoria* (1927, **25**, 403–408).

Banana Growing in Queensland. By C. N. Freeman. *Queensland Agric. Journ.* (1927, **28**, 60–63).

Brazilian Bananas. By A. Aspinall. *W.I. Comm. Circ.* (1927, **42**, 405).

Investigation on the Bunchy Top Disease of the Banana. By C. J. P. Magee. *Bull. No.* 30, *Council for Sci. and Indust. Res., Australia.* Pp. 64 + 22 plates, 9½ × 6. (Melbourne: Government Printer, 1927.)

Manuring of Citrus Trees. By P. Everett. *New Zealand Journ. Agric.* (1927, **35**, 38–41).

Notes on the Lemon Industry in Italy. By G. S. Cheema. *Bull. No.* 137 *of* 1927, *Dept. Agric., Bombay* Pp. 9, 9½ × 6. (Bombay: Superintendent of Government Printing, 1927) Price As.2 or 3*d.*

Experiments on the Preservation of Lime Juice at Peradeniya. By A. W. R. Joachim. *Trop. Agric., Ceylon* (1927, **69**, 155–158).

Produits Secondaires retirés des Limes Acides, des Citrons et des Bergamotes. By Max Fontaine. *Bull. Écon. Madagascar* (1926, **23**, 76–83).

De Bestrijding van de Stam-Gomziekte (Gummosis) bij den Sinaasappel (*Citrus aurantium*) in Britsch-Indië. By M. N. Kamat. *De Indische Culturen* (*Teysmannia*) (1927, **12**, 710–714.)

Date Culture in Egypt and the Sudan. By S. C. Mason. *Dept. Bull. No.* 1457, *U.S. Dept. Agric.* Pp. 72, 9 × 5¾. (Washington, D.C.: Government Printing Office, 1927.) Price 25 cents.

Some Changes occurring during the Ripening of Grapes. (Third Paper.) By P. R. v. d. R. Copeman. *Sci. Bull. No.* 60, *Dept. Agric., Un. S. Afr.* (*Div. of Chem. Ser. No.* 75). Pp. 19, 9½ × 6. (Pretoria: Government Printing Office, 1927.) Price 3*d.*

Passion Fruit Culture. By J. Farrell. *Journ. Agric., Victoria* (1927, **25**, 466–471).

The Peach Cottony Scale. By S. W. Harman. *Bull. No.* 542, *New York State Agric. Exper. Sta.* Pp. 19, 8¾ × 5¾. (Geneva, New York: State Agricultural Experiment Station, 1927.)

Proceedings of The Pineapple Men's Conference, March 23–26, 1927. Pp. 247, 9 × 6. (Honolulu: Association of Hawaiian Pineapple Canners, 1927.)

Review of Physiological and Pathological Studies on the Pineapple Plant. By C. P. Sideris. *Bull. No.* 8, *Exper. Sta. Assoc. Hawaiian Pineapple Canners, Univ. Hawaii.* Pp. 10, 10¼ × 6¾. (Hawaii: Association of Hawaiian Pineapple Canners, 1926.)

Pineapple Insects and Some Related Pests. By J. F. Illingworth. *Bull. No.* 9, *Exper. Sta. Assoc. Hawaiian Pineapple Canners, Univ. Hawaii.* Pp. 64, 10¼ × 6¾. (Hawaii: Association of Hawaiian Pineapple Canners, 1926.)

The Plum Curculio (*Conotrachelus nenuphar* Herbst.) and its Control in Quebec. By C. E. Petch. *Circ. No.* 27 (*revised*), *Entom. Branch, Dept. Agric., Canada.* Pp. 4, 9¾ × 6½. (Ottawa: King's Printer, 1927.)

The Cashew Nut By H Ludowyk *Trop Agric, Ceylon* (1927, **69**, 43–46).

The Development of the Pecan Nut (*Hicoria pecan*) from Flower to Maturity By J G Woodroof and N C Woodroof *Journ Agric Res* (1927, **34**, 1049–1063)

Co-operative Fruit Packing Houses Their Requirements and Problems By R J Benton and W H Brown *Agric Gaz, N S W* (1927, **38**, 557–565, 632–638)

Sulphuring Dried Fruit By W R Jewell *Journ Agric, Victoria* (1927, **25**, 457–462, 565–567)

The Codling Moth (*Cydia pomonella* L) By S L Allman. *Agric Gaz, N S W.* (1927, **38**, 551–556, 624–631, 699–706)

Spices

Der Anbau von Sussem Pfeffer als Gemuse By J C Th Uphof. *Tropenpflanzer* (1927, **30**, 378–379)

Fodders and Forage Crops

Seeds Mixture Problems By R G Stapledon, W Davis, and A R Beddows *Series H No* 6, *Seasons* 1923–1926 *Welsh Plant Breed Station, Univ Coll of Wales* Pp 70, 9¾ × 7¼ (Aberystwyth Agricultural Department, 1927) Price 3*s* 6*d*

Herbage Seed Production in New Zealand IV—Perennial Rye-Grass and Crested Dogstail By R G Stapledon *Journ Ministry Agric* (1927, **34**, 510–517)

Herbage Seed Production in New Zealand V—Species of Lesser Importance and General Conclusions as affecting the British Farmer By R G Stapledon *Journ Ministry Agric* (1927 **34**, 618–624)

On the Reclamation of Ruined Pasturage on the Amatolas, near Keiskama Hoek By S Schonland *Sci Bull No* 55, *Dept Agric, Un S Afr* Pp 15, 9½ × 6 (Pretoria Government Printing Office, 1927) Price 3*d*

Manurial Top-Dressing of Hill Grassland › Marlborough Some Recent Experimental Work By F W Greenwood *New Zealand Journ Agric* (1927, **35**, 89–95)

Pasture-Improvement Top-dressing Experiments with Potash and Nitrogen in Auckland Province By T H Patterson and J W Woodcock *New Zealand Journ Agric* (1927, **35**, 154–160)

The Sheep as a Grazing Animal and as an Instrument for Estimating the Productivity of Pastures By R G Stapledon and M G Jones. *Series H, No* 5 *Welsh Plant Breed Station, Univ Coll of Wales.* Pp 42–54 (Aberystwyth Agricultural Department, 1927) Price 3*s* 6*d*

Hay-making in Southern Rhodesia By C Mainwaring *Rhodesia Agric Journ* (1927, **24**, 1045–1048)

East African Pasture Plants II—East African Grasses By C E Hubbard Pp 56, 9½ × 6¼ (London Crown Agents for the Colonies, 1927) Price 3*s*

Uganda Grasses By T D Maitland and C E Hubbard *Kew Bull* (1927, No 7, pp 272–305)

Italian Rye-Grass for Winter and Early Spring Keep The Effect of Methods of Grazing on Productivity and Palatability, and on the Chemical and Botanical Composition of the Herbage By R G Stapledon, T W Fagan, R E Evans, and W E J Milton *Series H No* 5, *Seasons* 1925–1926, *Welsh Plant Breeding Station, Univ Coll of Wales* Pp 5–41 (Aberystwyth Agricultural Department, 1927) Price 3*s* 6*d*

Kentucky Bluegrass in Missouri By B M. King *Circ No* 155,

Missouri Agric. Exper Sta. Pp. 11, 9 × 6. (Columbia, Missouri. State University, 1927)

Production of Alfalfa on Range Lands of Saskatchewan and Alberta. By G P McRostie and S E Clark *Circ No* 53, *Forage Crop Div*, *Dom Exp Farms, Dept Agric, Canada* Pp 4, 9¾ × 6½ (Ottawa. King's Printer, 1927)

Red Clover Investigations By R D Williams *Series H*, *No* 7, *Seasons* 1919–1926, *Welsh Plant Breeding Station, Univ Coll of Wales.* Pp 136, 9¾ × 7¼ (Aberystwyth Agricultural Department, 1927) Price 5*s*. With Swedish Summary.

Experiments in Handling Sweet Clover with Reference to the Accumulation and Conservation of Nitrates in the Soil By A L. Whiting and T E Richmond *Bull No* 285, *Illinois Agric Exper. Sta.* Pp 287–307, 9 × 6 (Urbana, Illinois State University, 1927)

L'Utilisation du Luc-Binh (*Eichornia crassipes*) pour la Nourriture du Bétail By A Magen *Bull. Écon Indochine* (1927, **30**, 576–577)

The Nutritive Value of Dried Spent Hops By W L Davies and R S Sullivan *Journ Agric Sci* (1927, **17**, 380–387)

Some Digestibility Trials on Indian Feeding Stuffs (II) By P E Lander and Pandit Lal Chand Dharmani *Mem Dept Agric, India, Chem Ser* (1927, **9**, 63–83)

The Nutritive Value of Swedes, Marrow Stem Kale and Sugar Beet Tops By T B Wood *Journ Ministry Agric* (1927, **34**, 697–705)

Net-energy Values of Corn Silage, Soy Bean Hay, Alfalfa Hay, and Oats By E B Forbes, W W Braman, M Kriss, and others *Journ Agric Res* (1927, **34**, 785–796)

The Ensilage of Sugar Beet Tops By H E Woodman *Journ Ministry Agric* (1927, **34**, 761–764)

Oils and Oil Seeds

Oleos Vegetaes Brasileiros (inclusive Resinas, Gommas, Breus, Ceras) By Eurico Teixeira da Fonseca Pp 341, 9½ × 6½ (Rio de Janeiro 1927)

Falsche Kakaobutter (Benzin-Butter) *Gordian* (1927, **33**, 5876–5879).

Annual Report of the Coconut Experiment Stations in the Kasaragod Taluk of South Kanara District, Madras, for the Year 1926-27 Pp 44, 9¾ × 6 (Madras Superintendent, Government Press, 1927)

On the Occurrence on Coconut of *Rhizoctonia bataticola* (Taub) Butler By M Park *Trop Agric*, *Ceylon* (1927, **69**, 7–8)

Further Notes on *Rhizoctonia bataticola* (Taub) Butler By W. Small *Trop Agric*, *Ceylon* (1927, **69**, 9–12)

Annual Report of the Groundnut Experiment Station, Palakuppam, Madras, for the Year 1926–27 Pp 13, 9¾ × 6 (Madras Superintendent, Government Press, 1927)

État actuel de la Culture de l'Arachide au Sénégal By J Seguela. *Agron Col* (1927, **16**, 263–269, 302–308)

The Palm Kernel Trade of Sierra Leone By F J Martin *Bull No* 1, *Div Research, Lands and For Dept*, *Sierra Leone.* Pp 17, 9¼ × 7 (Freetown Government Printing Office, 1927)

Le Palmier à huile au Congo portugais et dans l'Enclave de Cabinda. By Janssens *Bull Agric Congo Belge* (1927, **18**, 29–92).

Machines modernes pour huilerie de Palme By F Bruyninckx. *Bull Agric Congo Belge* (1927, **18**, 136–152)

Contribution to the Study of the Crown Disease of the Oilpalm (*Elæis guineensis* Jacq) By C Heusser *Communications from the General Experimental Station of the A V R O S*, *Gen Ser No* 31. Pp 34, 11 × 7¼ (Medan Varekamp and Co)

Étude Chimique du Beurre d' "Owala" (*Pentaclethra macrophylla* Benth) du Gabon. By F. Heim de Balsac, G S Dagand, E Delhotel,

E. Garrigue, M Husson, A Parveaud, and H Heim de Balsac *Bull de l'Ag Gén des Col* (1927, **20**, 422–432, 609–615)

The Soya Bean (*Glycine hispida*) Pp 4 13 × 8½ (Liverpool Kelly and Company, 10, Irwell Chambers West 1927)

Die Sojabohne By A Zimmermann *Tropenpflanzer* (1927 **30**, 353–377)

Selection for Quality of Oil in Soy Beans By L J Cole, E W Lindstrom, and C M Woodworth *Journ Agric Res* (1927, **35**, 75–95)

Tung Oil (Chinese Wood Oil) from Australian-grown Trees of *Aleurites Fordii* By A R Penfold *Bull No* 12, *Technol Museum Sydney* Pp 9, 8½ × 5½ (Sydney Government Printer, 1926)

Essential Oils

Les Graminees à parfum (Espèces à Lemon-grass) By C Chalot *Agron Col* (1927, **16**, 270–276)

Les Citronnelles By C Chalot *Agron Col* (1927 **16**, 297–301)

Le Lavandin et son Essence By R -M G , La Lavande et son Territoire, La Récolte de la Lavande By P M , Sur les Butyrates de Linalyle et la teneur de l Huile de Lavande en Acétate de Linalyle By A Kaufman and F Kjelsberg *Parfumerie Moderne* (1927, **20**, 191–200)

Fibres

Final Forecast of the Indian Jute crop, 1927 *Indian Tr Journ* (1927 **86**, Supp to No 1110)

Étude technologique d'une filasse dénommée " Lingué ' (No 266) provenant de l A E F By J Dantzer *Agron Col* (1927, **16**, 289–290)

Nomenclature of the Abaca Plant By E B Copeland *Philippine Journ Sci* (1927, **33**, 141–153)

La Fibre du Bananier à Fruits (*Musa paradisiaca* L) et sa Valeur Textile By F Heim de Balsac, O Rœhrich and Ch Pontillon *Bull de l'Ag Gén des Col* (1927 **20**, 796–802)

Ramie Kultur und Verarbeitung By F Grunwald *Tropenpflanzer* (1927 **30**, 315–327)

Sisal growing in East Africa By B Hausberg *East Africa* (1927 **3**, No 146 pp 61–65)

Die wirtschaftliche Bedeutung des Henequén By J H H Ross *Tropenpflanzer* (1927 **30**, 395–399)

La Culture du Kapokier et la Préparation du Kapok à Java By Yves Henry *Bull Écon Indochine* (1927, **30**, 399–412)

Étude de l Aptitude à la Filature de la Soie Végétale de ' Madar (*Calotropis procera* Dryand) d Indochine By F Heim de Balsac and O Rœhrich *Bull de l Ag Gén des Col* (1927, **20**, 616–621)

The History of the Silkworm Industry By N K Jardine *Trop Agric, Ceylon* (1927, **69**, 39–41)

Le Commerce et l'Industrie de la Soie aux Indes Anglaises By Garreau-Dombasle *Bull Écon Indochine* (1927 **30**, 217–224)

La Crise de l'Industrie de la Soie au Japon By E Meric de Bellefon *Bull Écon Indochine* (1927, **30**, 225–235)

Recherches Expérimentales pour l Amélioration de la Sériculture au Tonkin By M Ressencourt *Bull Écon Indochine* (1927, **30**, 237–258)

Cotton

Gossypium By Sir George Watt *Kew Bull* (1927, No 8, pp 321–356)

The Indigenous Cotton Types of Burma By T D Stock *Mem Dept. Agric, India, Bot Ser* (1927, **14**, 177–187)

Artificial and Natural Asiatic-American Cotton Hybrids. By G. S. Zaitzer. *Agric. Journ., India* (1927, **22**, 261–268).

Le Coton en Nigéria. By Sir William Himbury. *Coton et Culture Cotonnière* (1927, **2**, 45–58).

Northern Rhodesia, Southern Rhodesia and Nyasaland as Sources for Increasing our Raw Cotton Supplies. By Sir William Himbury. *Public. No.* 100, *Brit. Cott. Gr. Assoc.* Pp. 67, 9½ × 5½. (Manchester: British Cotton Growing Association, 1927.) Price 1*s.*

The Union of South Africa as a Source for Increasing our Raw Cotton Supplies. By Sir William Himbury. *Public. No.* 99, *Brit. Cott. Gr. Assoc.* Pp. 53, 8½ × 5½. (Manchester: The British Cotton Growing Association, 1927). Price 1*s.*

Co-operation in South Africa. By T. G. Hesse. *Emp. Cotton Grow. Rev.* (1927, **4**, 337–343).

An Account of the Programme of Work of the Genetics Department, Cotton Research Station, Trinidad. By S. C. Harland. *Emp. Cotton Grow. Rev.* (1927, **4**, 325–329).

Le Coton aux Antilles. By R. C. P. Boone. *Bull. de l'Ag. Gén. des Col.* (1927, **20**, 765–774).

Étude Technologique de Cotons de Madagascar. By Heim de Balsac, O. Rœhrich and Ch. Pontillon. *Coton et Culture Cotonnière, Travaux de la Section des Cotons* (1927, **2**, 49–60).

La Campagne Cotonnière de 1926 en Algérie. By E. Vivet. *Coton et Culture Cotonnière, Travaux de la Section des Cotons* (1927, **2**, 67–70).

Les Irrigations du Niger et la Culture du Cotonnier en A. O. F. *Coton et Culture Cotonnière, Travaux de la Section des Cotons* (1927, **2**, 73–77).

La Production du Coton en Haute-Volta. By W. Lalande. *Coton et Culture Cotonnière Travaux de la Section des Cotons* (1927, **2**, 78–84).

La Production du Coton en Côte d'Ivoire. By W. Lalande. *Coton et Culture Cotonnière, Travaux de la Section des Cotons* (1927, **2**, 85–88).

Cotton Production in the United States. Crop of 1926. *Bur. of the Census, U.S. Dept. Comm.* Pp. 40, 9 × 5¾. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1927.) Price 10 cents.

The Thinning Operation in Cotton Growing. A Preliminary Note on the Time of Thinning in its Relation to the Early Development of the Seedling during Periods of Water Stress. By F. S. Parsons. *Emp. Cotton Grow. Rev.* (1927, **4**, 344–351).

Cotton Picking by Machinery. By R. Thomas. *Emp. Cotton Grow. Rev.* (1927, **4**, 352–364).

Some Notes on Cutworms in Cotton. By E. Ballard. *Queensland Agric. Journ.* (1927, **28**, 229–232).

Lygus elisus: A Pest of the Cotton Regions in Arizona and California. By E. A. McGregor. *Tech. Bull. No.* 4, *U.S. Dept. Agric.* Pp. 14, 9¼ × 5¾. (Washington, D.C.: Government Printing Office, 1927.) Price 5 cents.

Haitian Cotton and the Pink Bollworm. By G. N. Wolcott. *Bull. Entom. Res.* (1927, **18**, 79–82).

Factors Influencing the Severity of the Crazy-Top Disorder of Cotton. By C. J. King and H. F. Loomis. *Dept. Bull. No.* 1484, *U.S. Dept. Agric.* Pp. 22, 9 × 5¾. (Washington, D.C.: Government Printing Office, 1927.) Price 15 cents.

A Study of Fusaria common to Cotton Plants and Cotton Soils in the Central Provinces. By Jiwan Singh. *Mem. Dept. Agric., India, Bot. Ser.* (1927, **14**, 189–198).

The Gossypol Content and Chemical Composition of Cottonseeds during Certain Periods of Development. By W. D. Gallup. *Journ. Agric. Res.* (1927, **34**, 987–992).

Paper-making Materials

Report on a Paper-Pulping Reconnaissance Survey of the Chakrata Forest Division, U P By W Raitt *Indian Forester* (1927, **53**, 266–269)

Caroá Fiber as a Paper-making Material By M B Shaw and G W Bicking *Tech Pap U S Bur Stand* (No 340 1927, **21**, 323–346) Pp 23, 10 × 7 (Washington Government Printing Office, 1927) Price 25 cents

Newsprint Preliminary Experiments on the Grinding of Immature Eucalypts for Mechanical Pulp, and Possibilities of Manufacturing Newsprint in Australia By L R Benjamin *Bull No* 31, *Council for Sci and Indust Res Australia* (Melbourne Government Printer, 1927)

Rubber

Le caoutchouc aux Indes Néerlandaises By L Ph le Cosquino de Bussy *Bull Agric Congo Belge* (1927, **18**, 3–27)

La Question du Caoutchouc d'Ouest-Afrique Regard Rétrospectif sur un Ancien Centre de Production et d Achat By M Perron *Bull de l Ag Gén des Col* (1927, **20**, 758–764)

The Effect on Yield of Manuring Rubber with Nitrate of Soda By R H Stoughton-Harris *Trop Agric, Ceylon* (1927, **69**, 20–22)

Report on Rubber Tapping Experiments Experiment Station, Peradeniya, 1926 *Trop Agric, Ceylon* (1927, **69**, 57–61)

Die direkte Verwendung von Latex By A Zimmermann *Tropenpflanzer* (1927, **30**, 223–234)

The Selection of High Yielding Trees on Rubber Estates *Leaf No* 43, *Dept Agric, Ceylon* Pp 5, 9½ × 6 (Colombo Government Printer) Price 5 cents

Über Selektion bei Hevea By A Zimmermann *Tropenpflanzer* (1927, **30**, 268–291)

Longevity of *Hevea brasiliensis* (Yields of rubber from some of the oldest estates in Malaya) By F G Spring *Malayan Agric Journ* (1927, **15**, 208–238)

The Efficiency of Disinfectants and Fungicides By R H Stoughton *Bull No* 45, *Rubber Res Scheme Ceylon* Pp 12, 8½ × 5½ (Colombo Government Printer, 1927)

The Control of Bark Rot by Disinfectants By R H Stoughton *Bull No* 46 *Rubber Res Scheme, Ceylon* Pp 8, 8½ × 5½ (Colombo Government Printer, 1927)

Oidium Leaf Disease of *Hevea* By M Park *Trop Agric, Ceylon* (1927, **69**, 147–150)

Explanatory Notes on Vulcanisation Testing of Rubber By T E. H O Brien *Trop Agric, Ceylon* (1927 **69**, 13–19)

Eenige opmerkingen over exploitatie van Euphorbia's in Zuid-Africa, winning van hars en caoutchouc By W Spoon *Berichten van de afdeeling Handelsmuseum van de Kon Vereeniging Koloniaal Instituut No* 32 Pp 28, 8½ × 5½ (Amsterdam, 1927) Reprinted from *Indische Mercuur*, March 30, 1927

Tobacco

Tobacco Cultivation in the Southern Maratha Country By S S Salimath *Bull No* 140 *of* 1927, *Dept Agric, Bombay* Pp 13, 9½ × 6 (Bombay Superintendent of Government Printing 1927) Price As 3 or 4*d*

Nyasaland's Tobacco Industry By A V Maunder *East Africa* (1927, **3**, No 146, pp 109–113)

A Note on the Rhodesia Tobacco Crop of 1926–27. By D. D. Brown *Rhodesia Agric Journ* (1927, **24**, 787–792)

Tobacco Growing in North-Eastern Rhodesia By T S. Page. *East Africa* (1927, **3**, No 146, pp 103–107)

Synopsis of Information Covering the Tobacco Situation in Canada. By P C Armstrong Pp 3, 10½ × 8½ (Montreal Canadian Pacific Railway Company, 1927)

Verslag der Proeven omtrent den invloed van het aanplanten van verschillende Tweede gewassen op de Cultuur van Tabak in het gebied der Vorstenlanden op Java 1912-1920 By A N J Beets (with a summary in English) *Med No* 58, *Proefsta voor Vorstenlandsche Tabak* Pp 119, 10½ × 7¾ (1927)

Notes on the Manufacture of Tobacco in the Philippines By Domingo B Paguirigan *Philippine Agric Rev* (1927, **20**, 5–81)

A Study of the Cost of Production of Tobacco in the Cagayan Valley By Domingo B Paguirigan and Ulpiano V Madamba *Philippine Agric Rev* (1927, **20**, 83–115)

Wrapper Tobacco Production at the Pikit and Sarunayan Tobacco Experiment Stations and its Relations to the Philippine Tobacco Problem By Mariano E Gutierrez *Philippine Agric Rev* (1927, **20**, 117–133)

An Index to Bulletins, Circulars, and Articles on Tobacco published by the Bureau of Agriculture By E A Eduardo *Philippine Agric Rev* (1927, **20**, 179–184)

The Care of Tobacco Seed Beds By J C F Hopkins *Rhodesia Agric Journ* (1927, **24**, 736–739, 847–857, 931–935)

Voortzetting der veldproeven over vervanging van dessamest door kunstmeststoffen (2de publicatie) By P M Bartels (with a summary in English) *Med No* 57, *Proefsta voor Vorstenlandsche Tabak* Pp. 100, 10½ × 7¾ (1926)

Black Root-rot of Tobacco in New South Wales —*Thielavia basicola* (B and Br) Zopf By L F Mandelson *Agric Gaz , N S W* (1927, **38**, 523–531)

Drugs

Les Toxiques Vegetaux de Madagascar By Henri Jumelle *Bull Écon Madagascar* (1926, **23**, 63–68) (Reprinted from *La Nature*, Dec 18, 1926)

Annual Report of the Betel Vine Experiment Station, Vellatur, Madras, for the Year 1926-27 Pp 6, 9¾ × 6 (Madras Superintendent, Government Press, 1927)

Remedies for Koleroga Disease of Betelnuts *Leaflet No* 13 *of* 1926, *Dept Agric , Bombay* Pp 14, 9½ × 6 (Poona Yeravda Prison Press, 1926)

La Production de la Cannelle en Annam By G Frontou *Bull Écon Indochine* (1927, **30**, 307–325)

La piantagione italiana di " Cinchona " nell'Isola di Giava By Riccardo Catellani *Agricolt Col* (1927, **21**, 245–253, 290–299)

Contribution à l Etude du Frêne à Manne et de sa Culture —Manne By D Luciani *Notice No* 23, *Office National des Matières Premières végétales pour la Droguerie et la Parfumerie, Ministère du Commerce et de l Industrie* Pp 161, 19 plates, 10 × 6½ (Paris 12 Avenue du Maine, 1926) Price 15 frs

The Cultivation of Papaya and the Preparation of Papain *Leaf No* 44, *Dept Agric , Ceylon* Pp 5, 10½ × 6½ (Colombo Government Printer, 1926) Price 5 cents

Qualche notizia sulla " Fava Tonka " (*Coumarouna punctata* Blake). By R Ciferri *Agricolt Col* (1927, **21**, 377–384, *cont*)

Colouring Matters

An Improved Method of Growing Turmeric in the Deccan By H. M Desai *Bull No* 135 *of* 1927, *Dept Agric*, *Bombay* Pp 14 + 3 plates, 9¾ × 6¼ (Bombay Superintendent, Government Printing, 1927) Price 4 annas or 6*d*

Forestry

General

Annual Report of the Forest Department, Sarawak, for the Year 1926 Pp 9, 13 × 8¼. (Kuching Government Printing Office, 1927)

Report of the Forestry Department, Government of the Gold Coast, for the Period April, 1926—March, 1927 Pp 13, 13 × 8¼. (Accra Colonial Secretariat, 1927) Price 1*s*

Forestry in Southern Rhodesia Timber and Fuel for Tobacco Growers Yields from *Eucalyptus rostrata* and *E tereticornis* By J S Henkel *Rhodesia Agric Journ* (1927, **24**, 627–633)

The Sixth Annual Report of the Forest Department, Tanganyika Territory, 1926 Pp 15, 13 × 8¼ (Dar es Salaam Government Printer, 1927) Price 2*s* 50

Synopsis of Information Covering the Forest Situation in Canada Part I Eastern Canada, by R Black, pp 4 Part II Prairie Provinces, by W McNeill, pp 3 Part III British Columbia, by W McNeill, pp 13 Part IV Production, Imports, Exports, Tariff, pp 4 (Montreal Canadian Pacific Railway Company, 1927)

Report on the Forestry Department, British Guiana, for the Year 1926 Pp 10, 13×8¼ (Georgetown Government Printer, 1923)

Report of the Forest Trust, British Honduras, 1927 Pp 22, 13 × 7¾ (Belize The Clarion Press, 1927)

Seventh Annual Report of the Forests Commission of Victoria, Australia, for the Financial Year 1925 26 Pp 22, 13 × 8¼ (Melbourne Government Printer, 1927)

Annual Report, Director of Forestry, New Zealand, for the Year ended March 31, 1927 Pp 44, 13 × 8¼ (Wellington Government Printer, 1927)

Monograph on the New Zealand Beech Forests Part I The Ecology of the Forests and Taxonomy of the Beeches By L Cockayne. *Bull No* 4 *New Zealand State Forest Service* Pp 71, 9½ × 6¼. (Wellington Government Printer, 1926) Price 4*s*

Trees of Honduras By S J Record *Trop Woods* (1927, No 10, pp 10–47)

Experiments with Fertilising Eucalyptus Trees By J Watson *Rhodesia Agric Journ* (1927, **24**, 767 769)

Fires and Fire Protection in Chir (*Pinus longifolia*) Forests By H M Glover and N G Pring *Indian Forester* (1927, **53**, 328–340)

An Interim Report on the Progress of Investigations into the Origin of Twisted Fibre in *Pinus longifolia* Roxb. By H G Champion. *Indian Forester* (1927, **53**, 18–22)

How the Teak Pole Forests of Thana are Regenerated By G. E. Marjoribanks *Indian Forester* (1927 **53**, 125–131).

An Investigation of the Soil Conditions in Compartment 1, Bwet Reserve, Prome Division, Burma, with Reference to the Dying off of *Tectona grandis* By H E Castens *Silvicult Ser No* 12, *For Bull. No* 18, *Burma* Pp. 14, 9½ × 6¼. (Rangoon: Government Printing Office, 1927)

Le Ravenala de Madagascar. By M. Luc. *Agron. Col* (1927, **16**, 257–262).

The Relation of Insects to Slash Disposal. *Dept. Circ. No. 411, U S Dept Agric* Pp 12, 9 × 6 (Washington, D C.: Government Printing Office, 1927) Price 5 cents

The Relation of Highway Slash to Infestations by the Western Pine Beetle in Standing Timber By J E Patterson *Tech Bull. No 3, U S Dept Agric* Pp 10, 9¼ × 5¾ (Washington, D C · Government Printing Office, 1927) Price 5 cents

Preliminary Studies on the Relation of Fire Injury to Bark-Beetle Attack in Western Yellow Pine By J M Miller and J E Patterson. *Journ Agric Res* (1927, **34**, 597–613)

A Leaf-cast of the Douglas Fir due to *Rhabdocline pseudotsugæ* Syd. By W R Day *Quart Journ Forestry* (1927, **21**, 193–199)

Larch-Shoot Moths (*Argyresthia atmoriella* Bankes, *Argyresthia lævigatella* Zeller, *Argyresthia zelleriella* Hartig) *Leaflet No* 11, *Forestry Commission* Pp 4, 9¾ × 6 (London Forestry Commission, 1926) Gratis

Larch Canker (*Dasyscypha calycina* Fuckel) *Leaflet No* 16, *Forestry Commission* Pp 4, 9¾ × 6 (London Forestry Commission, 1927) Gratis

The Parasites of the Pine Tip Moth *Rhyacionia frustrana* (Comstock) By R A Cushman *Journ Agric Res* (1927, **34**, 615–622)

Timbers

Woods Native to the British Empire By P Harris Pp 20, 11 × 8½ *Reprinted from International Critical Tables* (1927 **2**, 16–34)

Some Commercial Softwoods of British Columbia their Mechanical and Physical Properties By T A McElhanney and R S Perry *Bull No 78 For Ser, Dept Inter, Canada* Pp 44, 9¾ × 6½ (Ottawa King's Printer, 1927) Price 25 cents

Durability Tests of Malayan and Other Timbers By F W. Foxworthy *Indian Forester* (1927, **53**, 25–33)

Comparative Strength Properties of the Principal Philippine Commercial Woods By J C Espinosa *Philippine Journ Sci* (1927, **33**, 381–395)

De Houtsoorten van Suriname By J Ph Pfeiffer Deel II Een onderzoek naar de technischen eigenschappen van acht-en-twintig van de voornaamste houtsoorten *Med No XXII, Afdeel Handelsmuseum No* 6 *Kon Ver Kol Inst Amsterdam* Pp 244 + Atlas of 18 Plates, 9 × 6½ (Amsterdam Druk de Bussy, 1927) Price Fl 7 50

Wood Borers Powder Post and Furniture Beetles By W B Gurney *Agric Gaz, N S W* (1927, **38**, 686–688)

Tanning Materials

A Survey of the Tanning Materials of Australia By D Coghill *Bull No* 32, *Council Sci and Indust Res, Australia* Pp 136, 9½ × 6 (Melbourne Government Printer, 1927)

Contribution à l'Étude des Écorces Tannifères de Madagascar I — Écorces de Mimosa By F Heim de Balsac, A Deforge, J Maheu, and H Heim de Balsac *Bull de l'Ag Gén des Col* (1927, **20**, 775–795)

Per la coltura industriale di una pianta concieante la *Cæsalpinia tinctoria* Dombey in Italia e Colonie By F Vignolo-Lutati *Agricolt Col* (1927, **21**, 254–257)

Valeur, comme Matière Tannante, de l'Écorce de "Cay-duoc-sanh" de Cochinchine By F Heim de Balsac and A Deforge *Bull de l'Ag Gén des Col* (1927, **20**, 601–608)

Preliminary Report on the Treatment of Redgum or Marri Kino (*Eucalyptus calophylla*) for the Preparation of Tannin Extract. By

D. Coghill. *Circ. No.* 9, *Council Sci. and Indust. Res., Australia.* Pp. 14, 9½ × 6. (Melbourne: Government Printer, 1927.)

Gums and Resins

The Resin Industry in India. By A. J. Gibson and C. T. Mason. *Indian Forester* (1927, **53**, 379–385).

Distillation of Agar oil. By R. N. De. *Indian Forester* (1927, **53**, 158–159).

Refining of Crude Katha. By J. Sen. *Indian Forester* (1927, **53**, 340–342).

MISCELLANEOUS ANIMAL PRODUCTS

Hides and Skins: World Production and International Trade. By J. Schnitzer. *Trade Promotion Series, No.* 50, *Bur. For. and Dom. Comm., U.S. Dept. Comm.* Pp. 210, 9 × 5¾. (Washington: Government Printing Office, 1927.) Price 35 cents.

NOTICES OF RECENT LITERATURE

Books for review should be addressed to "The Editor, Bulletin of the Imperial Institute, South Kensington, London, S.W.7."

KENYA FROM WITHIN. A SHORT POLITICAL HISTORY. By W. McGregor Ross, B.A., M.Sc., B.E., M.Inst.C.E., Director of Public Works 1905–23. Pp. 486, 8½ × 5½. (London: George Allen and Unwin, Ltd., 1927.) Price 18*s.*

This is an unconventional and very readable book on Kenya by a former Government official and member of the Legislative Council, whose standing and long residence in the country render the volume well worth perusal, whatever view may be held regarding the political and sociological opinions expressed and their bearing on the European, Indian, and native inhabitants. This is not the place to comment on such matters, but it may safely be presumed that some sections of the book will prove rather startling to many readers and will offer food for serious thought and discussion in Colonial circles.

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH—REPORT OF THE FOOD INVESTIGATION BOARD FOR THE YEARS 1925, 1926. Pp. vi + 80, 9½ × 6. (London: H.M. Stationery Office, 1927.) Price 2*s.* 6*d.*

This publication consists of a summary of the work done by the Board during the two years under review, together with a more detailed report by the Director of Food Investigation embodying technical accounts of the investigations on different problems carried out by individual workers.

Several of the investigations were undertaken under a scheme whereby research is carried out on behalf of outside bodies, the Board reserving the right to publish

the conclusions reached but without reference to the individual or firm concerned.

The problems attacked related chiefly to means of bringing food to the consumer in a healthy and attractive condition, and papers are included, *inter alia*, dealing with chemico-physical questions concerning the water in muscle, the transport of ham and bacon, various problems of refrigeration, and matters connected with the storage of apples.

In addition, a number of physico-engineering investigations are recorded, these relating mostly to testing and measuring apparatus required in dealing with food storage and other problems.

Some of the work recorded in the present Report has been published in the form of " Food Investigation Special Reports," e.g. those on " Temperature conditions in small cold storage chambers containing fruit " and " Gas storage of fruit," to which attention has already been drawn in this BULLETIN (1927, **25**, 54, 154).

LE BANANIER. By Ray. C. P. Boone. Pp. 346, 10 × 6½. (Paris : Société d'Éditions Géographiques, Maritimes et Coloniales, Ancienne Maison Challamel, 1926.) Price 60 francs.

This book affords a valuable account of the species of Musa of commercial importance and of the industries based upon their cultivation. During the last twenty years there have been remarkable developments in the banana fruit trade and although the bibliography of the plants concerned has become extensive (as shown in the list of literature which is included in the present book) the late Mr. Fawcett's standard work on " The Banana " has hitherto been the only modern account of the industry as a whole. The new book under notice, while not adding substantially to the information furnished by Fawcett, is a useful addition to the literature.

By the inclusion of short notes on those species of Musa which yield valuable fibres (*M. textilis*, *M. Ensete*, *M. Livingstoniana*, *M. ulugurensis*) and of others which are esteemed for ornamental properties (e.g. *M. assamica*, *M. coccinea*, *M. rosacea*) the author has provided a survey of the industrial application of the genus Musa as a whole, but the book is concerned almost entirely with the edible bananas, viz. *Musa sapientum* (West Indian banana), *M. chinensis* (Canary banana) and *M. paradisiaca* (plantain). The chapters concerned may be grouped into three main sections, dealing respectively with the cultivation of the plants, the commercial application of the fruits, and

the chief producing industries. In the first section there is a detailed account of the varieties of banana, while in the purely cultural chapters much useful information is given regarding the climatic and soil conditions desirable for plantations, manurial requirements, propagation, pests and diseases. The chapter dealing with yield includes estimates of the costs of production on plantations, based on information derived from Jamaica, French Guinea, Nicaragua and elsewhere. Methods of packing and transporting the fruit are also described. In the section dealing with the uses of the fruits much attention is given to their chemical composition as an indication of food value, and in the accounts of the preparation of dried bananas and banana flour, analyses of the latter product are furnished. Information is also given regarding banana sugar and the preparation of alcohol from the ripe fruits. In the chapters dealing with the trade in bananas useful information has been compiled regarding the production of the fruit in different countries of the world. The book contains a number of reproductions from photographs, but could not claim to be well illustrated.

Sugar. By the late George Martineau, C.B., revised by F. C. Eastick, M.A., A.I.C., F.C.S., Hon. F.G.I. Pitman's Common Commodities and Industries. Pp. xi + 159, 7 × 4¾. Fifth edition. (London: Sir Isaac Pitman & Sons, Ltd., 1927.) Price 3*s*.

This book first appeared in 1910, and was designed to provide a concise and popular account of the sugar industry from the growing of the raw material to the marketing of the product ready for the consumer. The book was admirably written by the late Mr. Martineau, who prepared three further editions before his death in 1919. In the fifth edition the work has been revised and brought up to date by Mr. Eastick. The most important addition is an account of the production of white granulated sugar direct from the juice of the cane or beet, a method that is being adopted by the new English factories. The book deals not only with the growing of cane and beet, and the preparation and refining of sugar, but also with the development of the industry. The changes that have taken place from time to time are admirably described. Of special interest is the chapter entitled " Diplomacy."

Oleos Vegetaes Brasileiros. By Eurico Teixeira da Fonseca. Pp. 341, 9½ × 6½. (Rio de Janeiro, 1927.) Second Edition.

Besides dealing with the vegetable fatty oils as indicated in the title, this book treats also of the essential oils, gums,

resins and waxes that are produced in Brazil. In the earlier part of the volume tables are given showing the imports of materials used in the perfumery, paint, dyeing and other industries of Brazil, and the exports of oilseeds, cotton-seed cake and vegetable oils from that country. The main portion of the work is devoted to a detailed description of different materials contained in the above-named classes of products together with the results of their analysis. The book is very comprehensive, and, in view of the hitherto unexploited resources of Brazil and the interest that is now being taken in their development, it should be very useful.

The Industrial Chemistry of the Fats and Waxes. By T. P. Hilditch, D.Sc., F.I.C. Pp. xv + 461, $8\frac{1}{2} \times 5\frac{1}{2}$. (London: Baillière, Tindall & Cox, 1927.) Price 18s.

This is one of a series of volumes on industrial chemistry, written under the editorship of E. de Barry Barnett, D.Sc., F.I.C., with the object of giving a comprehensive survey of the various chemical industries. The works are primarily intended for chemists, though the chemical engineer and technologist should also find them useful.

The author in his preface to the volume under review states that the book is written not only for those already at work in the industries employing fats and waxes but also for the student proposing to become engaged in fat technology. The subject is treated in such a manner as to afford an introduction to the chemical technology involved, to survey the outlets for the materials and to emphasise throughout the connection between chemical constitution and the particular economic application.

The first two sections of the book are devoted to an account of the chemical nature and composition of fats. Then follows a chapter dealing with the methods of their transformation for industrial use, such as their extraction, refinement, hydrogenation and hydrolysis. The edible fat and the soap industries are next described. Sections follow in which are treated the subjects of the use of fats for candle manufacture and as illuminants, the production of glycerine, and the use of fats and waxes in the paint and varnish industries. The chapter entitled the application of fats to fibres deals with the production of linoleum; the uses of sulphonated oils; wool and cloth oils; and fatty oils in the leather industry. The final section is devoted to fatty lubricants.

It has not been possible in the space of this volume to deal in full detail either with engineering and plant construction or with the more intricate side of analytical pro-

cedure. Such subjects are adequately treated in standard text-books and at the end of each section of the present volume references are given to the appropriate works which will furnish any specialised data required.

THE COTTON WORLD: A SURVEY OF THE WORLD'S COTTON SUPPLIES AND CONSUMPTION. Founded on Lectures delivered at the City School of Commerce, Liverpool. Compiled and edited by John A. Todd, M.A., B.L. Pp. viii + 236, 7½ × 5. (London: Sir Isaac Pitman & Sons, Ltd., 1927.) Price 5s. net.

This work consists of summaries of courses of lectures in which the following took part: T. D. Barlow, M.A., R. Brooks, W. Cunliffe, E. J. Griffith, J. R. Hannay, B. Hesketh, B. H. Hird, B.A., F. Holroyd, Owen Jones, B.A., J. Millward, A. Bryce Muir, the late Prof. Wm. Myers, M.Sc., T. G. G. Powell, W. E. Shepherd, Col. J. J. Shute, C.M.G., D.S.O., John A. Todd, Percy White and J. C. Withers, Ph.D. The lectures were given at the City School of Commerce, Liverpool, to persons engaged in the Liverpool cotton trade. The summaries were first prepared for the convenience of the students, and two of them appeared in the *Journal of the Liverpool Chamber of Commerce*. The demand for the summaries became so great that it was decided that they should be brought together in book form.

It is obviously impossible to give a detailed account of the world's cotton industry, including production, manufacture, consumption of raw cotton and manufactured articles, marketing and trade organisation, within the limits of so small a book. Professor Todd has accomplished his task with much success, but, as he points out, the book suffers from the severe compression which was necessary. For example, the whole of the processes of cotton manufacture are described in 24 pages. The most valuable chapter in the work is undoubtedly that on the Liverpool Cotton Market, as it contains much information which is not easily available elsewhere.

The work can be recommended as giving a general concise survey of the cotton industries. In order that a reader who may wish to extend his knowledge in any direction may know where to turn for information, a list of useful publications is appended to each chapter.

MODERN INDUSTRIAL TENDENCIES. By Sir Chas. W. Macara, Bart. Pp. xii + 259, 7½ × 5. (Manchester: Sherratt and Hughes, 1926.)

This volume consists largely of reprints of articles written at different times for many journals at home and

abroad, and some repetition has, therefore, been unavoidable. They deal primarily with the position of the British cotton industry and contain the author's views as to the causes of the difficulties with which that industry is faced to-day. In his opinion little prospect of improvement can be hoped for in the absence of effective organisation to secure greater co-operation between capital and labour and control of output. He stresses the importance of obtaining stability by the formation of a cotton reserve in superabundant years and by the issue of reliable and full statistics of production, consumption and stocks.

While some of the matter in this little book is of a controversial nature, the opinions of one who has devoted a lifetime to textile production will repay careful examination, not only by all those who are directly interested in the state of our cotton trade, but also by students of industrial and economic problems.

The Timber Trade of the United Kingdom. By Thomas J. Stobart. Vol. I.—Softwoods. Pp. xiv + 116, $7\frac{1}{4} \times 4\frac{3}{4}$; Vol. II.—Hardwoods. Pp. xiii + 103, $7\frac{1}{4} \times 4\frac{3}{4}$. (London: Crosby Lockwood and Son, 1927.) Price 5*s*. per volume.

In these two small volumes the author, who is a trade journalist of long standing, has succeeded in giving a most readable account of the organisation and working of the timber business of this country. The extent of this business may be gauged from the fact that in 1926 the value of the imports into the United Kingdom of softwoods alone amounted to approximately £30,000,000, while hardwoods accounted for a further £8,000,000.

The numerous countries of origin of the raw material and the extraordinary variety of consuming industries no doubt explain in some measure the complexity of the trade organisation which comes between the standing timber in the forest and the mechanic in the workshop. The author appears to be equally at home in the softwood and hardwood sections of the trade and has clearly explained the functions of the shipper, agent, importer, merchant and broker. The two volumes are planned on essentially the same lines. A discussion of the annual imports of timber is followed by a useful description of the timbers received and the sources of production, a story which indicates the relatively small part played by the Empire in supplying the timber required in industry. The organisation of the buying and selling departments of the trade is carefully elucidated and the author has taken the opportunity to explain the systems of " marks," grades

and measurements adopted in the softwood trade, a subject which presents no little difficulty to the layman. The volume on softwoods has sections dealing with the pit-wood business, the timber trade press and trade associations, while that on hardwoods contains chapters on plywood and related materials (laminated wood and veneers), and wood-working machinery. In both volumes there are appropriate chapters on the home timber trade. The books are illustrated with interesting photographs and contain up-to-date statistical tables.

FOREST PRODUCTS: THEIR MANUFACTURE AND USE. By Nelson Courtlandt Brown, B.A., M.F. Second Edition, Revised. Pp. xvii + 447, 9 × 5¾. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1927.) Price 20s.

The second edition of this publication does not differ in its general features from the first, which was reviewed in this BULLETIN (1920, **18**, 145). Statistics have been brought up to date, particulars relating to costs have been modified, and additions or alterations have been made where necessary in the light of recent developments. A few illustrations have been added, and the index has been cut down from twenty-six pages to three.

MANUAL OF FOREST ENGINEERING AND EXTRACTION. By J. F. Stewart, F.R.S.G.S., Lecturer in Forest Engineering, Edinburgh Universit Pp. xv + 188, 8½ × 5½. (London: Chapman & Hall, Ltd., 1927.) Price 15s.

This is a concise, well-arranged and thoroughly practical handbook, which, though intended primarily for forestry students, should be very useful to forest engineers and others engaged in the extraction of timber and its preparation for shipment. The contents include chapters on exploration and camping, surveying, felling and clearing, log transport, wire-rope haulage, forest roads and railways, buildings and bridges, and the conversion and seasoning of timber. Many useful illustrations and diagrams are provided.

In an introductory chapter it is emphasised that the profession of forestry has now attained great importance, and that whilst the forest officer cannot be an expert in everything concerning forest exploitation, he nevertheless requires some knowledge, such as that given here, of engineering methods and other technical matters outside the purely scientific aspect of his work. As a practical forest engineer and University lecturer, the auth r is well

qualified for the proper presentation of his subject, and, as is pointed out in an Introduction contributed by Professor E. P. Stebbing, the volume should "prove of great assistance to all who aim at making themselves efficient to fill a post either in timber exploitation or as Forest Officer."

ROOT DEVELOPMENT OF VEGETABLE CROPS. By John E. Weaver and William E. Bruner. Pp. xiii + 351, 9 × 6. (London: McGraw-Hill Publishing Co., Ltd., 1927.) Price 20s.

In the detailed study of the living crop plant, attention has hitherto been confined almost entirely to the aerial portion—the stem, leaves and flowering shoot. The authors have performed a useful service in directing attention to the importance of an intensive study of the root system, which varies in character, not only from crop to crop, but to some degree according to the nature of the soil. The book is based to a large extent on the authors' own investigations and is complementary to the senior author's *Root Development of Field Crops*, issued by the same publishing house in 1926. It deals with all the ordinary vegetable crops of the garden, except the potato, which is discussed in the volume on Field Crops. In most cases a description of the root system at different stages, from the early development to maturity, is given. A prominent feature is the excellent series of original drawings showing the distribution of the roots in the soil, the size being indicated by means of one-foot squares. It will probably be surprising to most people to learn that the tap-root of the radish may descend to a depth of over 7 ft., although in this case the bulk of the fibrous roots are situated in the top twelve inches of soil and extend horizontally to distances 3 ft. or more on all sides of the plant. The roots of mature horse-radish (ten years old) were traced to a depth of 14 ft. The labour involved in working out the distribution of the roots must have been considerable. A trench was dug to a depth of 5 ft. and of convenient width by the side of the plants to be examined and deepened as necessity arose, depths of 6 to 11 ft. being frequently reached.

FERTILISERS AND SOIL IMPROVERS. DESCRIPTION, APPLICATION, AND COMPARATIVE VALUE. By W. Gardner. Pp. vii + 184, 7½ × 5. (London: Crosby Lockwood & Son, 1927.) Price 7s. 6d.

This useful addition to the series of Lockwood Manuals is an introduction to the nature of the soil and the sources and functions of fertilisers, and at the same time a practical

guide to the rational application of fertilisers to different crops under varying conditions. It is mainly concerned with artificial manures, but also includes information regarding natural products used as manures, and there are references to a number of proprietary and "special" fertilisers, as well as to substances which, though not plant foods, have a beneficial effect on crop production. The principles underlying the valuation of manures are explained in a final chapter.

Artificial Fertilisers: Their Chemistry, Manufacture and Application. By P. Parrish, A.I.C., M.I.Chem.E., and A. Ogilvie, A.M.I.Mech.E., with a foreword by Dr. H. C. Brown, F.I.C. Vol. I. Pp. 356, 9½ × 7. (London: Ernest Benn, Limited, 1927.) Price 45s.

This book is the first of two volumes on the subject of artificial fertilisers. It deals almost entirely with phosphatic fertilisers. Nitrogen and potassium compounds are considered only in connection with compound manures, but presumably they will receive more adequate treatment in the succeeding volume. More than half the book is taken up with a full account of the history, chemistry and manufacture of superphosphate, together with a description of the chief classes of raw phosphates employed. Various types of plant used for each of the different processes are described and illustrated by photographs and diagrams, and comparative working costs are given in several cases. Differences between English and American practice are pointed out where they occur. The large number of interesting illustrations and tables is an important feature of the book.

The authors refer to the critical state of the British superphosphate industry at the present time and suggest that the Government might aid the industry by supplying the British manufacturer with Nauru phosphate for a period, free of interest and sinking fund charges. Reference is made to recent work showing the importance of fine grinding of phosphate rock in improving the quality of the superphosphate produced and in lessening the consumption of acid. A chapter is devoted to the methods of dealing with the toxic gases evolved in the process of manufacture and their recovery as sodium silicofluoride.

The second half of the book deals with compound manures and basic slag. The importance of collaboration between the fertiliser manufacturer and farmer in regard to the supply and use of compound manures is emphasised. Various types of mixing plant are fully described, and a short chapter is devoted to the manufacture of phosphoric

acid and of double superphosphate, both from bones and from phosphate rock. In conclusion, there is an interesting summary of the trend of future developments, including a review of different processes suggested for rendering the phosphate of phosphate rock more available for plant nutrition.

The book will undoubtedly prove of much value to all those engaged in, or interested in, the manufacture of fertilisers, both at home and in the colonies.

Phosphoric Acid, Phosphates, Phosphatic Fertilisers. By Wm. H. Waggaman, assisted by H. W. Easterwood. Pp. 370, 9 × 6. (New York: The Chemical Catalog Company, Inc., 1927.) Price $7.50.

This book gives a comprehensive account of the occurrence, properties, manufacture and uses of phosphoric acid and its compounds, with particular reference to the United States.

The introduction deals with the historical aspects of phosphatic fertilisers, the chemistry of phosphorus, its oxides and acids, the importance of phosphates in animal metabolism and in agriculture, and the natural sources of phosphoric acid (bones, guano, apatite and phosphate rock). The chapter closes with a few remarks on the use of ground raw phosphate rock as a fertiliser, but the authors do not appear to attach as much importance as present day experience would seem to warrant to this direct application of the mineral.

The origin, occurrence and working of phosphate rock in different parts of the United States are dealt with very fully, the phosphate rocks of other countries receiving much shorter treatment. Numerous references to fuller sources of information on the different deposits are given.

The next section deals with the so-called "available phosphates," of which the chief are steamed bone and basic slag. Various suggested processes for the direct production of available phosphates from phosphate rock without the use of mineral acids are described, but none of these appear to have yet reached a stage of commercial importance.

Chapter 5 deals with the manufacture of acid phosphate (usually called superphosphate outside America), both from the mechanical and chemical points of view, including the effects of the various common impurities met with in phosphate rock. An account is then given of the manufacture of "double superphosphate," and of some of the newer fertilisers such as ammonium phosphate.

The manufacture of phosphoric acid by the sulphuric acid and the volatilisation processes is adequately described.

The last three chapters deal with the minor uses of phosphoric acid and phosphates, including phosphate baking powders, water softeners and a number of smaller uses. These constitute one of the best features of the book.

The book contains a number of misprints, e.g. "annular production of phosphate rock" (p. 90); "hydrogen iron concentration of acids" (p. 292); "exhausting investigations" (p. 205). It is difficult, also, to account for the erratic use of inverted commas for some chapter and section headings, especially in the latter half of the book.

The book is written almost exclusively from the American point of view. For instance, every conceivable U.S. patent referring to phosphoric acid in any form is mentioned, but there are practically no references to the patents of any other country. In this limited sense it is a very satisfying book and it should prove very useful to anyone interested in American practice on this subject.

Sheep Production. By Levi Jackson Horlacher, B.S.A., M.S. Pp. x + 418, 9 × 6. (New York: McGraw-Hill Book Company, Inc.; London: McGraw-Hill Publishing Co., Ltd., 1927.) Price 20s.

This book is an outcome of the author's work in the teaching of sheep production at Kentucky University. He has made use of existing American publications, including the bulletins and circulars of the United States Department of Agriculture and the various Experiment Stations, and the result is a volume that is likely to be of considerable interest to all sheep breeders who care to study their subject systematically and on a scientific basis with a view to obtaining the best results. The author is careful, however, to point out that his views on certain questions may require modification to suit particular conditions.

The first part deals with the development of sheep production and its position in various countries, the anatomy and interior economy of the animal, and the various points taken into account in judging sheep, and concludes with a chapter on sheep-breeding in which Mendelian and other principles are considered and the technique of the subject is discussed. This is followed by a section relating to different breeds of sheep, successive chapters being devoted to a number of the principal breeds of interest in the United States.

The third part is concerned with various matters of flock management, fattening, marketing, the wool clip, etc., and at the end there is an informative glossary of terms used in sheep breeding and the wool industry.

THE ECONOMIC RESOURCES OF THE EMPIRE. Edited by T. Worswick, O.B.E., M.Sc. Pp. viii + 167, $7 \times 4\frac{1}{2}$. (London: Sir Isaac Pitman & Sons, Ltd., 1927.) Price 5*s.*

The scope of this volume is more limited than the somewhat ambitious title would suggest. The contents consist of a series of ten lectures delivered at the Regent Street Polytechnic in London by persons specially qualified to discuss the economic position of the Dominions and India. Great Britain is dismissed in 11 pages, and the Colonies and Protectorates are not dealt with at all. The lectures are of a topical and popular nature and are necessarily too brief to present any exhaustive account of the subject, but within their limits they are readable and instructive.

THE RURAL INDUSTRIES OF ENGLAND AND WALES. Vol. III. Decorative Crafts and Rural Potteries. By Helen E. Fitzrandolph and M. Doriel Hay. Pp. xii + 168, $8\frac{1}{2} \times 5\frac{1}{2}$. Vol. IV. Wales. By Anna M. Jones. Pp. xi + 123, $8\frac{1}{2} \times 5\frac{1}{2}$. (Oxford: The Clarendon Press, 1927.) Price 5*s.* per volume.

These are two volumes of an instructive and useful series, which records the results of a survey of rural industries made by various investigators on behalf of the Agricultural Economics Research Institute at Oxford. Apart from their general interest they are of value both as a record of certain existing industries which seem likely to disappear under modern conditions, and as a guide to local authorities and others concerned with schemes for fostering and developing those which are economically suited to survive. The volumes form noteworthy contributions to the permanent literature of the subject.

LAND TENURE AND AGRICULTURAL PRODUCTION IN THE TROPICS. BEING A DISCUSSION ON THE INFLUENCE OF THE LAND POLICY ON DEVELOPMENT IN TROPICAL COUNTRIES. By H. Martin Leake, Sc.D. (Camb.). Pp. ix + 139, $8\frac{1}{2} \times 5\frac{1}{2}$. (Cambridge: W. Heffer and Sons, Ltd., 1927.) Price 7*s.* 6*d.*

As may be gathered from the title of this volume, the contents are of a somewhat academic nature. The author rightly points out in his Preface that " land tenure is a subject full of complexities " and that it " constitutes a problem on which it is extremely difficult, if not impossible, to generalise." His main contention appears to be that the moral and material progress of tropical dependencies is best advanced by a " triple partnership "

in the land; the partners being the Government (as representing the community), an effective intermediate agent or "landlord," and the cultivator. In view of his long experience in India he has devoted a chapter to "The Indian Tenure System," and has reprinted, as appendixes to the book, two articles contributed by him to the *Agricultural Journal of India*, to which is added an article, entitled "Some Thoughts on Land Tenure in Tropical Africa," reprinted from the *Empire Cotton Growing Review*.

Dr. Leake's treatise should prove instructive to students of economics in relation to land tenure, and to Government officials and others concerned in the development of tropical countries, especially in cases where Government policy in relation to the land is still in the experimental stage.

Teaching Agricultural Vocations. A Manual for Teachers in Preparation and in Service. By Rolland Maclaren Stewart and Arthur Kendall Getman. Pp. vii + 377, 8 × 5½. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Limited, 1927.) Price 15*s*.

This practical and well-arranged work, written by two American specialists in agricultural education, is stated in the preface to be designed "especially for teachers and prospective teachers of agricultural vocations in schools and departments of secondary grade." It is primarily a textbook for American teachers of the type in question, but in view of its scope and the useful suggestions offered by the authors regarding methods, curricula and organisation, it should prove helpful to those concerned with systematic agricultural instruction in British countries.

Alluvial Prospecting. The Technical Investigation of Economic Alluvial Minerals. By C. Raeburn, D.Sc., F.G.S., and Henry B. Milner, M.A., D.I.C., F.G.S., F.R.G.S., M.Inst.P.T. Pp. xix + 478, 8½ × 5½. (London: Thomas Murby & Co.; New York: D. Van Nostrand Company, 1927.) Price 36*s*.

The title "Alluvial Prospecting" on the cover of this work is somewhat misleading, as it would lead one to expect only details of the methods of alluvial prospecting, equipment required, the field determination of the more usual and interesting minerals contained and possibly a short description of the mode of occurrence of such deposits. The book goes much further than this, however, as it deals with the formation of placers, and aims at giving full details for the determination in the laboratory of all

minerals likely to occur in them. Indeed, these laboratory details occupy more than half the volume, a fact which fully justifies the sub-title given on the title page, viz. "the technical investigation of economic alluvial minerals."

The first four chapters embrace, in considerable detail, the classification of alluvial and allied deposits, the petrology of the rocks found and the theories of transport and accumulation of placers. Chapter V deals with the methods of prospecting, and contains all the essential details to be considered in deciding on the best method of prospecting a particular area, while the next chapter is devoted to a short description of the recent geophysical methods of prospecting and their value in connection with the investigation of alluvial deposits.

A brief account is given in Chapter VII of the field methods of examination of alluvial concentrates and determinative tables are added to help the prospector, while in the next chapter the framing of the report on results, a very important part of the work of a prospector or engineer, is dealt with, and the main points to be considered in recording the details are mentioned. Chapter IX deals with the laboratory investigation of minerals occurring in alluvial deposits, and includes sections on goniometrical measurements, microscopic, spectrographic and X-ray tests. In Chapter X the laboratory investigations are continued, dealing with the crystallography and other descriptive features of the minerals found, and at the end of this chapter are given lists showing the properties and conditions of occurrence of all minerals likely to be found in alluvial deposits.

THE WORKING OF COAL AND OTHER STRATIFIED MINERALS. By H. F. Bulman, M.Inst.M.E., A.M.Inst.C.E., F.G.S. Pp. 338, 9½ × 6. (London: Ernest Benn, Limited, 1927.) Price 42s.

This book is a companion volume to one dealing with the mining of lode deposits of all descriptions which has been written by a well-known American engineer. The author, who is a well-known authority on coal mining, has not only had an extensive experience in Great Britain, but is also conversant with the extraction of mineral from bedded deposits in other parts of the world.

As might be expected from the predominance of coal over other kinds of stratified deposits, a large part of the volume is devoted to coal mining. A general section, with which the book commences, deals with the structure of coal seams and the diversified conditions met with; the opening up of coal beds, including considerations as to the most

suitable positions for the shafts or other approaches; shaft pillars and main roadways.

Several chapters on coal mining in England and Wales, which cover over one hundred pages, describe numerous modifications of the longwall and bord and pillar systems of mining, each worked by retreating or advancing methods, as carried out in practice. The advantages and disadvantages under the various conditions encountered are practically and economically discussed. Methods of timbering and of stowing or filling the goaf, both by hand and hydraulically, are described in detail. The full description, which follows, of coal mining in the United States, with its different conditions and developments, should prove of great interest to British engineers.

Coal mining in India, South Africa and Australia, the last including the extraction of brown coal from the Latrobe Valley deposit in Victoria, are fully described in subsequent chapters, and two other chapters deal with the getting of coal, including holing, shot-firing and explosives used, and the mechanical loading and conveying of coal.

The rest of the book is devoted to the mining of stratified deposits of minerals other than coal, including the auriferous conglomerates of the Rand, ironstone in England, oil shale in Scotland, china clay and china stone in Cornwall, salt in England and potash salts in Germany. A chapter on the quarrying of slate, limestone, marble and building stones completes the volume, which is very clearly and interestingly written, and is well illustrated by over 200 excellent drawings and photographs. Its value is increased by the large amount of useful detail given, and by its index.

The Iron Ores of Lake Superior. By Crowell and Murray, Inc. Sixth Edition. Pp. vii + 365, 9 × 6. (Cleveland, Ohio: The Penton Press Co., 1927.) 30*s*.

The fact that this book is a sixth edition is evidence that it fills a want. The authors, a firm of mining engineers, have been assisted in its production, as in former editions, by a number of specialists on various subjects. The history, geology and topography of the Lake Superior iron-ore regions form an introduction, and are followed by descriptions of the methods employed in the exploration of orebodies, in the estimation of reserves and in the mining of ore from the surface and underground, where eight different systems are in use, all of which are fully described. Sections of the book, which follow, deal with the sampling of deposits by churn and diamond drilling, sampling of cargoes of ore, methods of analysis of samples,

the beneficiation of ores by various mechanical, heat and chemical methods, ore reserves, blast-furnace practice and dock equipment.

In the remainder of the book, amounting to two-thirds of the whole, are lists of the operating mines, their location and equipment and the expected 1927 analyses of their ores. A number of original maps of the different ranges or districts are inserted with the text. The book should prove of great value to all interested in mining in the Lake Superior region.

TITANIUM: WITH SPECIAL REFERENCES TO THE ANALYSIS OF TITANIFEROUS SUBSTANCES. By William M. Thornton, Jr. Pp. 262, 9 × 6. (New York: The Chemical Catalog Company, Inc., 1927.) Price $5.00.

Original literature regarding the chemistry of titanium and titaniferous materials is widely scattered, and the present volume provides an excellent compilation of knowledge now available on the subject.

The greater part of the book is concerned with the matter specified under the sub-title, but a useful summary of the industrial applications of titanium and its compounds is given in Chapter IV. Part II of the book, comprising "The Detection and Estimation of Titanium in its Various Associations," will prove of great value to those desiring more than a superficial knowledge of the analytical chemistry of titanium and titaniferous materials. It includes three chapters on gravimetric, colorimetric and volumetric methods for the estimation of titanium, and one on the application of these methods to the analysis of titaniferous materials. The chapters are very complete, the majority of known methods of analysis being described, with abundance of detail in the case of those of proved value.

The usefulness of the book is enhanced by copious references, in a bibliography of some 26 pages. The use of asterisks for numbering sub-sections is perhaps open to objection, especially when these amount to as many as ten, as on page 188. The book should prove of much value to all interested in titanium.

F. B. I. YEAR BOOK: A REGISTER OF BRITISH MANUFACTURES, 1927–8. Edited by W. S. Barclay, F.R.G.S., and Ernest A. Nash, Associate I.E.E., A.C.I.S. Pp. 460 + 220, 9½ × 7. (London: Federation of British Industries, 1927.) Price 15s.

This useful annual publication contains lists of the companies, firms and trade associations that are members

of the Federation of British Industries, arranged both under " Products and Services " and also alphabetically; in addition a list of brands and trade names is provided. An introductory section gives a brief account of the organisation, objects and work of the Federation.

BOOKS RECEIVED FOR NOTICE

A TEA MANUAL FOR BEGINNERS. By J. W. S. Pp. xii + 128, 8½ × 5½. (Colombo: The Ceylon Advertising Co., Ltd., 1926.) Price Rs. 7.50.

ORCHARDING. By Victor Ray Gardner, Frederick Charles Bradford and Henry Daggett Hooker. Pp. xi + 311, 9 × 5¾. (London: McGraw-Hill Publishing Co., Ltd., 1927.) Price 15s.

SEED PRODUCTION AND MARKETING. By Joseph F. Cox and George E. Starr. Pp. xviii + 450, 8 × 5½. (New York; John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1927.) Price 10*s.* 6*d.*

SOIL MANAGEMENT. By Firman E. Bear, Ph.D. Second edition. Pp. v + 412, 9 × 5¾. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1927.) Price 17*s.* 6*d.*

FARM SOILS: THEIR MANAGEMENT AND FERTILIZATION. By Edmund L. Worthens, M.S. Pp. x + 410, 8 × 5½. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1927.) Price 13*s.* 6*d.*

MANURES AND MANURING. A Handbook for Practical Farmers, Students and others. By Frank Ewart Corrie, B.Sc., N.D.A., N.D.D. Pp. xi + 168, 7¼ × 4¾. (London: Chapman & Hall, Ltd., 1927.) Price 5*s.*

THE GOLD COAST FOREST: A STUDY IN SYNECOLOGY. By T. F. Chipp, M.C., Ph.D. Oxford Forestry Memoirs, Number 7, 1927. Pp. 94, 11 × 7½. (Oxford: The Clarendon Press, 1927.)

RECENT ADVANCES IN TROPICAL MEDICINE. By Sir Leonard Rogers, C.I.E., M.D., B.S.(Lond.), F.R.C.P., F.R.C.S., F.R.S. Pp. viii + 398, 8 × 5. (London: J. & A. Churchill, 1928.) Price 12*s.* 6*d.*

THE STRUCTURE OF THE ALPS. By Léon W. Collet, D.Sc. Pp. xii + 289, 8¾ × 5½. (London: Edward Arnold & Co., 1927.) Price 16*s.*

GEOLOGISCHES PRAKTIKUM. By Professor Dr. Rudolf Sokol. Pp. viii + 248, 9½ × 6. (Berlin: Verlag von Gebrüder Borntraeger, 1927.) Price 14.50 Gold Marks.

GUIDE PRATIQUE DE LA PROSPECTION DES MINES ET DE LEUR MISE EN VALEUR. By Maurice Lecomte-Denis. Fourth edition. Pp. xx + 710, 10 × 6½. (Paris: Dunod, 1927.) Price, bound Frs. 111, unbound Frs. 100.

ELEMENTS OF OPTICAL MINERALOGY: An Introduction to Microscopic Petrography. By N. H. Winchell and A. N. Winchell. Second edition, entirely rewritten and much enlarged by A. N. Winchell. Part II, Descriptions of Minerals. Pp. xvi + 424, 9½ × 6. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1927.) *27s. 6d.*

SOIL MINERALOGY. By Frederick A. Burt. Pp. vii + 82, 8 × 5½. (New York: D. Van Nostrand Company, Inc., 1927.) Price $1.50.

HANDBOOK OF ORE DRESSING. By Arthur F. Taggart. Pp. xvii + 1679, 7¾ × 4¾. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1927.) Price 50*s.*

THE METALLURGIST'S MANUAL. By T. G. Bamford, M.Sc., and Harold Harris, M.Sc., F.C.S. Pp. x + 246, 8½ × 5½. (London: Chapman & Hall, Ltd., 1927.) Price 15*s.*

COAL IN GREAT BRITAIN. By Walcott Gibson, D.Sc., F.R.S. Revised and Enlarged Edition. Pp. viii + 334, 8½ × 5½. (London: Edward Arnold & Co., 1927.) Price 21*s.*

CLAYS: THEIR OCCURRENCE, PROPERTIES AND USES. By Heinrich Ries, Ph.D. Third Edition, revised and enlarged. Pp. vii + 613, 9 × 5¾. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1927.) Price 35*s.*

MANUFACTURE AND USES OF CONCRETE PRODUCTS AND CAST STONE. By H. L. Childe. Pp. x + 248, 8½ × 5½. (London: Concrete Publications Limited, 1927.) Price 5*s.*

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Botanical names and titles of books are printed in italics and authors' names in capitals